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ABSTRACT

This document contains an executive summary and main report that examine the ways in which the Alberta, Canada, economy benefits from the presence of the 16 community and technical colleges in the province. The colleges served an unduplicated headcount of 241,992 students in fiscal year 2001. The Alberta community colleges employed 8,374 full-time and 7,892 part-time faculty and staff in fiscal year 2001, amounting to a total annual payroll of some $503.7 million. The CC districts pay wages and salaries, which generate additional incomes as they are spent. Likewise, the aggregate college operating and capital expenditures generate still further earnings. Altogether, these earnings account for $673.7 million annually in the Province of Alberta economy (equal to that of 21,669 jobs). The spending by the 16 institutions explained $673.70 million, or 1.4%, of all province-wide earnings in 2001. The study indicates that every tax dollar invested in the institutions today will return a cumulative $9 over the next thirty years. Students benefit from an annual return of 14% on their investment of time and money. The study also quantifies the effects of CCs on reduction of crime, welfare, and unemployment. Appended in the main report is: Explaining the Results--A Primer. (Contains 47 references.) (NB)

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# The Socioeconomic Benefits Generated by 16 Community Colleges and Technical Institutes in Alberta

## Executive Summary

## [and]

## Volume 1: Main Report

Kjell A. Christophersen & M. Henry Robison

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# The Socioeconomic Benefits Generated by 16 Community Colleges and Technical Institutes in Alberta

## Executive Summary

**8-Jan-2003**

Kjell A. Christophersen & M. Henry Robison

CCbenefits Inc.

www.ccbenefits.com

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# Executive Summary

**HIGHLIGHTS**

- The 16 community colleges and technical institutes in Alberta pay $503.7 million in direct faculty and staff wages and salaries, and explain an additional $1,605 million in wages and salaries off campus.
- Taxpayers see a real money "book" return of 16.4% on their annual investments in the community colleges and technical institutes and recover all investments in 8.1 years.
- Students enjoy an attractive 14% annual return on their investment of time and money—for every $1 the student invests in a college education, he or she will receive a cumulative $3.76 in higher future earnings over the next 30 years.
- The province of Alberta benefits from improved health and reduced welfare, unemployment, and crime, saving the public some $56.3 million per year.

## INTRODUCTION

**How does the economy of Alberta benefit from the presence of the 16 community colleges and technical institutes in the province?** An obvious question often asked, but rarely answered with more than anecdotes. The Alberta community colleges, technical institutes, and Alberta Learning contracted with CCbenefits, Inc. to apply a comprehensive economic model they have developed to capture and quantify the economic and social benefits of community colleges (CCs). The model, which took over a year to develop with funding from the Association for Community College Trustees (ACCT), relies on data collected from individual CCs and technical institutes, and translates these into common sense benefit-cost and investment terms. It has been subjected to peer review, field tested on over 220 different CCs throughout the United States, and now applied to the community colleges and technical institutes in Alberta. Model results are based on solid economic theory, carefully drawn functional relationships, and a wealth of national and local education-related data. The model provides relief from the all-too-common "advocacy analyses" that inflate benefits, understate costs, and thus discredit the process of higher education impact assessment.

Four types of benefits are tracked: (1) contributions to local job and income formation (regional economic benefits); (2) higher earnings captured by exiting students; (3) a broad collection of social benefits (improved health, reduced crime, and lower welfare and unemployment); and (4) the return to taxpayers for their CC and TI support.

## THE RESULTS

For a more in depth exploration of the study, the reader is encouraged to consult the main report containing the detailed assumptions, their context, and the computation procedures.

➢ **Province-wide Perspective**

The existence of the 16 CCs and technical institutes in Alberta explains $2,103.5 million of all annual earnings in the



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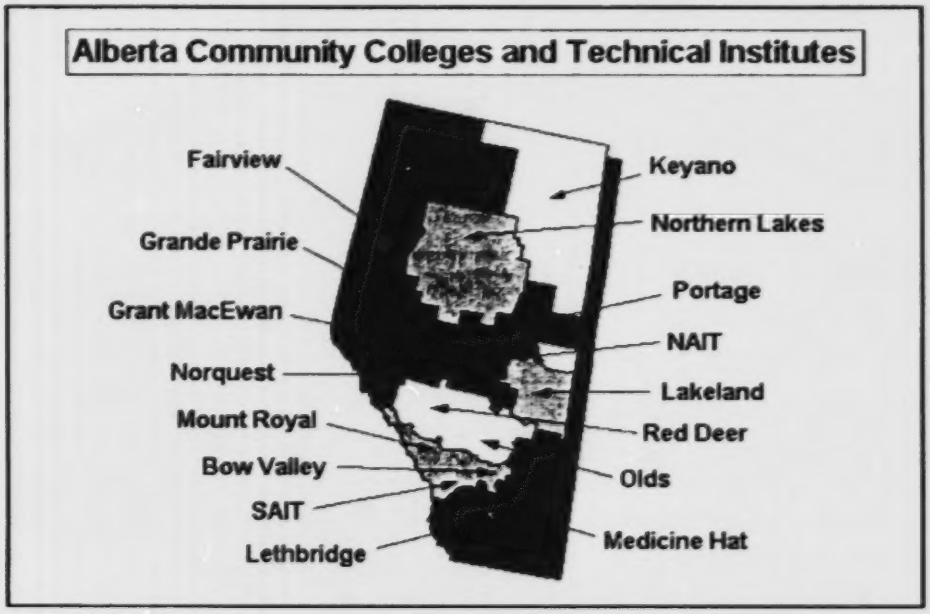
provincial economy (see map). The earnings explained by the CCs and institutes are equal to that of roughly 67,280 jobs. The earnings and job effects break down as follows:

- *Operations and Capital Spending*

The 16 community colleges and technical institutes in Alberta pay wages and salaries, which generate additional incomes as they are spent. Likewise, the aggregate CC and TI operating and capital expenditures generate still further earnings. Altogether, these earnings account for $673.7 million annually in the Alberta economy (equal to that of 21,669 jobs).




- *Higher Earnings due to Past Instruction*

Each year students leave the 16 CCs and technical institutes and join or rejoin the local workforce. Their added skills translate to higher earnings and a more robust economy. Based on current enrollment, turnover, and the growth of instruction over time, the workforce embodies an estimated 51.3 million credits of past instruction (credit and non-credit hours). The accumulated contribution of past CC and TI instruction adds some $1,434.8 million in annual earnings to the Alberta economy (equal to that of 45,610 jobs).

➢ **Student Perspective**

The student's perspective on the benefits of higher education is the most obvious: he or she sacrifices tuition and current earnings for a lifetime of higher earnings. For every credit completed students will, on average, earn $67 more per year every year they are in the workforce. Alternatively, for every full-time year they attend they will earn an additional $1,904 per year. In the aggregate (all exiting students), the higher earnings amount to some $269.4 million per year for each year they remain in the workforce.

From an investment standpoint, the students will, on average, enjoy a 14% rate of return on their investments of time and money, which compares favorably with the returns on other investments, e.g., the long-term return on US stocks and bonds. The corresponding B/C ratio (the sum of the discounted future benefits divided by the sum of the discounted costs) is 3.8, i.e.,

for every $1 the student invests in education at a community college or technical institute, he or she will receive a cumulative of $3.76 in higher future earnings over the next 30 years or so. The payback period (the time needed to recover all costs) is 10.1 years.

➢ **Taxpayer Perspectives**

The provincial government spent $436,250,681 in support of Alberta's colleges and institutes during the analysis year. Is this a good use of taxpayer money? Our analysis indicates that the answer is a resounding yes: returns far outweigh the costs, particularly when a collection of social savings is included in the assessment. For example, persons with higher education are less likely to smoke or abuse alcohol, draw welfare or unemployment benefits, or commit crimes. This translates into associated dollar savings (avoided costs) amounting to some $16 per credit per year, counted as an indirect benefit of education at a CC or technical institute. When aggregated across all exiting students, the province of Alberta will benefit from $56.3 million worth of avoided costs per year, broken down as follows:

- *Improved Health*

Alberta employers will see health-related absenteeism decline by 109,811 days per year, with a corresponding annual dollar savings of $15.9 million. The province will benefit from the health-related savings of 4,509 fewer smokers and 943 fewer alcohol abusers. The corresponding dollar savings are $11,603,388 and $12,289,422 per year, now and into the future (these savings include insurance premiums, co-payments and deductibles, and withholding for Medicare).

- *Reduced Crime*

Studies show that incarceration drops with each year of higher education. In Alberta, 30 fewer individuals will be incarcerated per year, resulting in annual savings of $308,576 (combined savings from reduced arrest, prosecution, jail, and reform costs). Reductions in victim costs (e.g., property damage, legal expenses, lost workdays, etc.) result in savings of $369,422 per year. Finally, that people are employed rather than incarcerated adds $192,535 of earnings per year to the economy.

- *Reduced Welfare/Unemployment*

There will be 1,184 fewer people on welfare, and 1,574 fewer drawing unemployment benefits per year, respectively, saving some $4,587,544 and $11,062,346 per year in the province.

➢ **Taxpayer Return on Investment**

The return on a year's worth of the provincial government investment in Alberta's 16 Community Colleges and Technical Institutes is obtained by projecting the associated educational benefits into the future, discounting them back to the present, and weighing these against the $436,250,681 that provincial taxpayers spent during the analysis year to support the 16 CCs and technical institutes in the system. The analysis assumes that without the provincial government support (54% of the budgets on average) the 16 colleges and institutes would have to shut their doors. Two investment perspectives are possible, one broad and one narrow.

- *Broad Perspective*

Taxpayers expect their annual investment in the CCs and technical institutes to result in higher lifetime earnings for students and social savings from lifestyle changes (reduced crime, welfare and unemployment, and improvements in health). From a broad investment perspective, the value of all future earnings and associated social savings is compared to the year's worth of provincial taxpayer support that made the benefits possible. Following this procedure, the B/C ratio generated for the whole system is 8.9, i.e., every dollar of provincial tax money invested in Alberta's community colleges and technical institutes today returns a cumulative of $9 over the next 30 years.

- *Narrow Perspective*

The narrow perspective limits the benefit stream to provincial government budgets, namely increased tax collections and expenditure savings. For example, in place of total increased student earnings, the narrow perspective includes only the increased provincial tax receipts from those higher earnings. Similarly, in place of overall crime, welfare, unemployment and health savings, the narrow perspective includes only those portions that translate to actual reductions in provincial government expenditures.

Note here that it is normal for the provincial government to undertake activities wanted by the public, but which are unprofitable in the marketplace. This means that positive economic returns are generally not expected from government investments. From the narrow taxpayer perspective, therefore, even a small positive return (a B/C ratio equal to or just greater than 1, and/or a rate of return equal to or just greater than the 4.0% discount rate used in this analysis) would be a most favorable outcome, certainly one that justifies continued taxpayer support of the college. For Alberta, the narrow perspective results greatly exceed the minimum expectations. The results indicate strong and positive returns: a RR of 16.4%, a B/C ratio of 2.4 (every dollar of provincial tax money invested today returns a cumulative $2.40 over the next 30 years), and a short payback period of only 8.1 years.

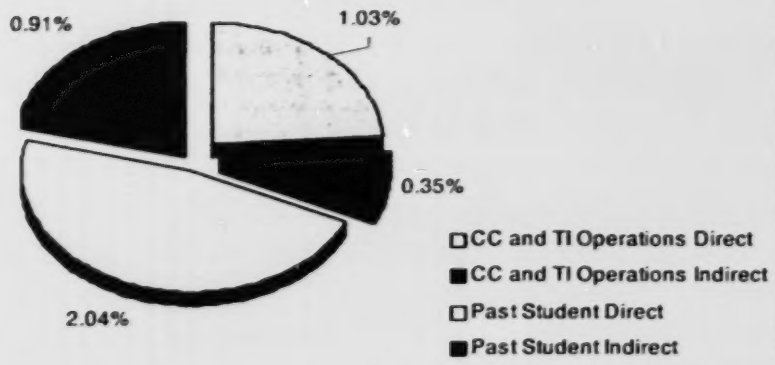
## CONCLUSION

The results of this study demonstrate that the investment in Alberta's 16 community colleges and technical institutes is sound from a multiple of perspectives. It enriches the lives of students while reducing the demand for taxpayer-supported social services. Finally, it contributes to the vitality of the provincial economy.

## Benefits at a Glance

| Provincewide Analaysis | | | Province Impact |
|---|---|---|---|
| **Provincewide Economic Development** | | | |
| Increment from CC and TI operations | | | $673,696,000 |
| Increment from past student productivity | | | $1,434,842,000 |
| Total | | | $2,108,538,000 |
| Job equivalent | | | $67,280 |
| **Annual Benefits** | | | |
| *Higher earnings* | | | |
| Aggregate (all students) | | | $269,433,406 |
| Per Credit | | | $67 |
| Per year per average student | | | $1,904 |
| *Social savings* | | | |
| Aggregate (all students) | | | $56,278,138 |
| Per Credit | | | $16 |
| Per year per average student | | | $457 |
| **Investment Analysis** | **RR** | **B/C Ratio** | **Payback** |
| Students | 14% | 3.8 | 10.1 |
| Taxpayers: Broad Perspective | NA | 8.9 | NA |
| Taxpayers: Narrow Perspective | 16% | 2.4 | 8.1 |

**Role of 16 CCs and TIs in Provincial Economy, % of All Earnings Explained by CC and TI Operations**




In sum, the graph shows that the colleges and technical institutes explain a total of 4.3% of all earnings ($48.70 billion) generated from all sources in the provincial economy.

This short summary report is one of six products generated for this impact study. In addition, one long report intended for economists and community college or technical institutional researchers (65 pp) lays out the detailed assumptions and analysis. Another report (10 pp) provides detailed tabular results by gender and entry levels of education, and a one-page fact sheet contains highlights of the study results at a glance. Another one-page document discusses the taxpayer perspective results in layman's terms Lastly, a PowerPoint presentation is developed showing the main results for CC and TI Presidents to adapt and use in speeches before provincial legislators and other education stakeholders.



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# The Socioeconomic Benefits Generated by 16 Community Colleges and Technical Institutes in Alberta

## Volume 1: Main Report

9-Jan-2003

Kjell A. Christophersen & M. Henry Robison

CCbenefits Inc.
www.ccbenefits.com

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CCbenefits Inc. is a company created in collaboration with the Association of Community College Trustees (ACCT) to provide economic analysis services to 2-year technical and community colleges. Questions of a technical nature concerning the approach, assumptions, and/or results should be directed to CCbenefits, Inc., c/o Drs. Kjell Christophersen and Hank Robison, 1150 Alturas Dr. Suite 102, Moscow ID 83843, phone: 208-882-3567, fax: 208-882-3317, e-mail: ccb@turbonet.com.



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# ACRONYMS

| | |
|---|---|
| ABE | Adult basic education |
| ACCT | Association of Community College Trustees |
| B/C | Benefit–cost ratio |
| CC | Community College |
| CHE | Credit hour equivalent |
| ESL | English as a second language |
| HS | High school |
| IO | Input–output analysis |
| NCF | Net cash flow |
| NPV | Net present value |
| REIS | Regional Economic Information System |
| RR | Rate of return |
| TI | Technical Institute |

# Preface

The Association of Community College Trustees (ACCT) contracted with the authors in 1999 to create the model used in this study. The original vision was simple—to make available to colleges a generic and low cost yet comprehensive tool that would allow them to estimate the economic benefits accrued by students and taxpayers as a result of the higher education achieved. In short, it only makes economic sense for the students to attend college if their future earnings increase beyond their present investments of time and money; likewise, taxpayers will only agree to fund colleges at the current levels or increase funding if the economic benefits exceed the costs.

An important requirement of the ACCT vision was that the model reach far beyond the "standard" study—the computation of the simple multiplier effects stemming from the annual operations of the colleges. Although the standard study was part and parcel of the model ultimately developed, it was only a relatively small part. The current model also accounts for the economic impacts generated by past students who are still applying their skills in the workforce; and it accounts for a number of external social benefits such as reduced crime, improved health, and reduced social assistance (welfare) and unemployment, which translate into avoided costs to the taxpayers. All of these benefits are computed for each college and then analyzed. The analysis is based on regional data adjusted to local situations to the greatest extent possible.

Although the written reports generated for each college are similar in text, the results differ widely. This, however, should not be taken as an indication that some colleges are doing a better job than others in educating the students. Differences among colleges are a reflection of the student profiles, particularly whether or not the students are able to maintain their jobs while attending, and the extent to which provincial taxpayers fund the colleges. Some students give up substantial earnings while attending college because employment opportunities are few and far between. In other cases they are able to work while attending because the area has an abundance of opportunities. Therefore, if the average student rate of return for College A is 15%, and the rate of return for College B is 20%, that does not mean that B is doing a better job than A. Rather, it is attributable to the employment opportunities in the region, and to the fact that one college may cater more to women than to men, or to minorities, and/or to different kinds of students such as transfer, workforce or retired, etc. In turn, the student body profiles are associated with their own distinct earnings functions reflecting these employment and gender

differences. The location of the college, therefore, dictates the profile of the student body, which, to a large extent, translates into the magnitudes of the results. In this sense, it could be that College A, which has a 15% student rate of return, is actually a better or more efficiently managed school than College B, which has a 20% student rate of return. The qualitative difference in management efficiency is not equal to the difference between the two returns.

# Chapter 1
# INTRODUCTION

## OVERVIEW

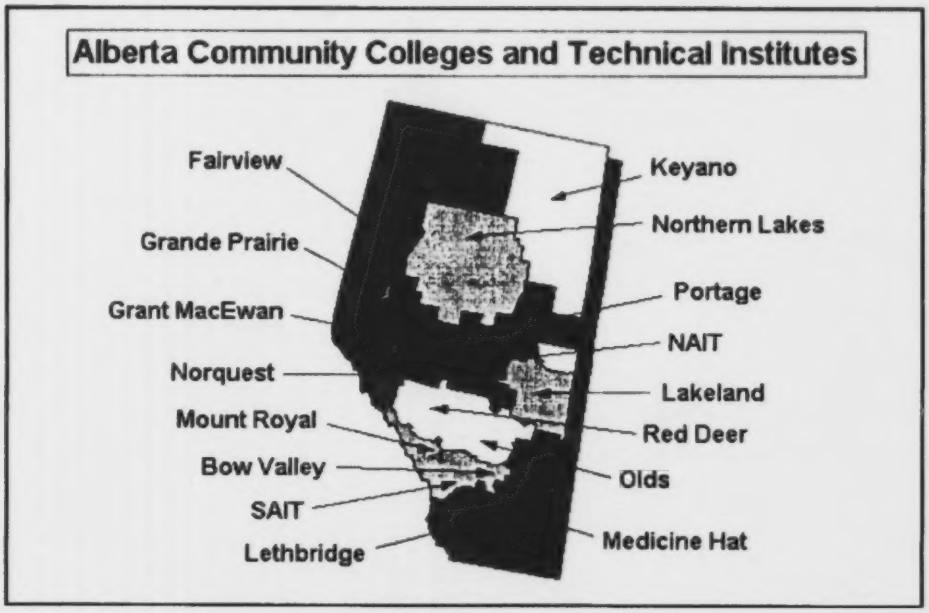
Alberta's 16 community colleges and technical institutes generate a wide array of benefits. Students benefit directly from higher personal earnings, and society at large benefits indirectly from cost savings (avoided costs) associated with reduced social assistance and unemployment, improved health, and reduced crime. Higher education requires a substantial investment on the parts of the student and society as a whole, however. All education stakeholders—taxpayers, legislators, employers, and students—want to know if they are getting their money's worth. In this study, Alberta's 16 community colleges and technical institutes investigate the attractiveness of the returns that they generate in the province (**Table 1.1** and **Figure 1.1**) relative to alternative public investments. The benefits are presented in three ways: 1) annual benefits, 2) present values of future annual benefits (rates of return and benefit-cost ratios, etc.), and 3) province-wide economic benefits, including returns to the business community.

The study has four chapters and two appendices. **Chapter 1** is an overview of the benefits measured. **Chapter 2** details the major assumptions underlying the analysis. **Chapter 3** presents the main socioeconomic, business, and province-wide economic results. Finally, **Chapter 4** presents a sensitivity analysis of some key assumptions—tracking the changes in the results as assumptions are changed. **Appendix 1** is a short primer on the context and meaning of the investment analysis results—the net present values (NPV), rates of return (RR), benefit/cost ratios (B/C), and the payback period.

Table 1.1. Alberta Participating CCs and TIs, Credit Enrollment

| Name of College | Abbreviation | Enrollment |
|---|---|---|
| Bow Valley College | BVC | 9,926 |
| Fairview College | FC | 3,431 |
| Grande Prairie Regional College | GPRC | 2,427 |
| Grant MacEwan College | Grant MacEwan | 15,574 |
| Keyano College | Keyano | 2,326 |
| Lethbridge Community College | LCC | 7,389 |
| Lakeland College | LC | 6,405 |
| Medicine Hat College | MHC | 4,527 |
| Mount Royal College | MRC | 11,265 |
| NorQuest College | NQC | 7,203 |
| Northern Lakes College | NLC | 3,485 |
| Northern Alberta Institute of Technology | NAIT | 19,862 |
| Olds College | OC | 1,782 |
| Portage College | Portage | 1,501 |
| Red Deer College | RDC | 6,061 |
| Southern Alberta Institute of Technology | SAIT | 20,715 |
| Total | | 123,879 |

Figure 1.1. Geographical Distribution of Participating CCs and TIs



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## ANNUAL PRIVATE AND PUBLIC BENEFITS

Private benefits are the higher earnings captured by the students; these are well known and well documented in economics literature. Less well known and documented are the indirect benefits, or what economists call *positive externalities*, which are a collection of public benefits captured by society at large, such as improved health and lifestyle habits, lower crime, and lower incidences of social assistance and unemployment. These stem from savings to society as taxpayer-provided services are reduced. We estimate dollar savings (or avoided costs) from reduced arrest, prosecution, jail, and reform expenditures based on published crime statistics arranged by education levels. Likewise, statistics that relate unemployment, social assistance, and health habits to education levels are used to measure other savings. The annual economic impacts are presented in three ways: 1) per credit-hour equivalent (CHE), defined as a combination of credit and non-credit attendance[1], 2) per student, and 3) in the aggregate (province-wide).

## PRESENT VALUES OF FUTURE BENEFITS

The annual impacts continue and accrue into the future and are quantified and counted as part of the economic return of investing in education. This lifetime perspective is summarized as *present values*–a standard approach of projecting benefits into the future and discounting them back to the present. The present value analysis determines the economic feasibility of investing in CC or TI education—i.e., whether the benefits outweigh the costs. The time horizon over which future benefits are measured is the retirement age (65) less the average age of the students.

The present values are also expressed in four ways: 1) net present value (**NPV**) total, per CHE, and per student, 2) rate of return (**RR**) where the results are expressed as a percent return on investment, 3) benefit/cost (**B/C**) ratio—the returns per dollar expended, and 4) the payback period—the number of years needed to fully recover the investments made (see **Appendix 1** for a more detailed explanation of the meaning of these terms).

[1] Instruction hours are not the same as credit hours. CCs prepare people for jobs and are less concerned with degrees. Many attend for short periods and then leave to accept jobs without graduating. Others simply enroll in non-academic programs. Nonetheless, the CHEs earned will positively impact the students' lifetime earnings and social behavior.

## PROVINCE-WIDE ECONOMIC AND BUSINESS COMMUNITY BENEFITS

The benefits of a robust economy are many: jobs for the young, increased business revenues, greater availability of public investment funds, and eased tax burdens. The activities of Alberta's 16 community colleges and technical institutes benefit provincial businesses directly by raising the skill level of the local labor force and providing opportunities for direct contract training of employees. Provincial businesses also benefit as the presence of a trained labor force works to attract new industry and increase the efficiency, competitiveness and output of existing industry. All these together spell a more effective and robust local economy.

In this study we show the impact of Alberta's colleges and institutes as a creator of earnings in the provincial economy. Increased earnings are displayed by industrial sector, and the role of Alberta's colleges and institutes in the local economy is then indicated by the percentage of sector-by-sector earnings explained by the college or institute. The geographic boundaries of the regional economy used in this report are shown in **Figure 1.1.** In general, these CC and TI-linked earnings fall under two categories: 1) earnings generated by the annual operating expenditures of the colleges and institutes; and 2) earnings attributable to the CC and TI skills embodied in the workforce.

# Chapter 2
# DATA SOURCES AND ASSUMPTIONS

## INTRODUCTION

To the extent possible, documented statistics are used to estimate model parameters. In the few cases where hard data are scarce, however, the institutional researchers on the scene apply well-informed judgments and estimations on the basis of their intimate knowledge of their colleges and the student bodies.

This chapter contains six assumption sections, all based on various data imbedded in the analytic model: 1) the aggregate profiles of the 16 community colleges and technical institutes; 2) annual earnings by education levels; 3) the social benefit assumptions (health, crime, and social assistance/unemployment); 4) education costs; 5) other assumptions (the discount rate used, health, crime, and social assistance cost statistics, etc.); and 6) assumptions pertaining to province-wide economic effects.

## PROFILE

### Faculty, Staff, and Operating Budgets

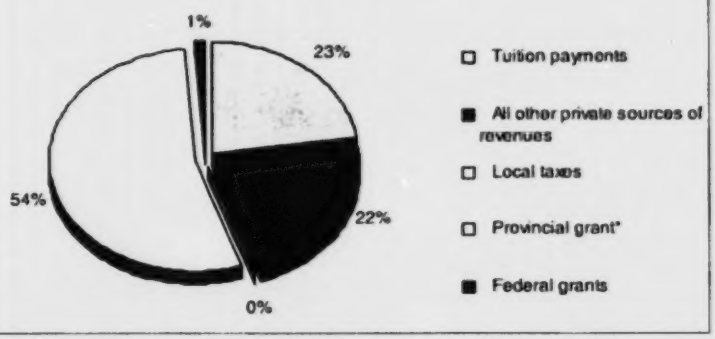
The Alberta colleges and institutes employed 8,374 full- and 7,892 part-time faculty and staff in fiscal year 2001 amounting to a total annual payroll of some $503.7 million. **Table 2.1** shows the aggregate annual revenues by funding source: a total of $805 million. Two main revenue sources—private and public—are indicated. Private sources include tuition and fees (22.8%) plus 21.9% from other private sources (such as contract revenues, interest payments and the like). Public funding is comprised provincial aid (54.2%) and federal grants (1.1%). These budget data are critical in identifying the annual costs of educating the student body from the perspectives of the students and the taxpayers alike.

Table 2.1. Aggregate Revenues, the Budget

| Sources | Revenues | Total | % of Total |
|---|---|---|---|
| **Private Funding** | | | |
| Tuition payments | $183,614,644 | | 22.8% |
| All other private sources of revenues | $176,060,399 | $359,675,043 | 21.9% |
| **Public Funding** | | | |
| Local taxes | $0 | | 0.0% |
| Provincial grant* | $436,250,681 | | 54.2% |
| Federal grants | $8,800,772 | $445,051,453 | 1.1% |
| Total | | $804,726,496 | 100% |

*The provincial grants include the following: Canada Study Grant, Disabled Student Grant, Maintenance Grant, Skills Development Grant, Alberta Opportunities Grant, Canada Millennium Bursary, and Grant for Disabled.

**Figure 2.1. Revenues: The Budget**




## The Students

Students attend community colleges and technical institutes for different reasons: to prepare for transfer to four-year institutions, to obtain diplomas or certificates, to obtain basic skills, or perhaps to take refresher courses in non-credit programs—workforce students, for example. Students also leave for various reasons, such as they may have achieved their educational goals or decided to interrupt their college career to work full-time. **Tables 2.2 – 2.4** summarize the student body profiles for the 16 community colleges and technical institutes in the province of Alberta. The unduplicated student body (headcount) is 241,992 (FY01 enrollment).

Some students forego earnings entirely while attending college while others may hold full or part-time jobs. Information about student employment plays a role in determining the *opportunity cost* of education incurred by the students while attending

the Alberta CC and TI system[2]. **Table 2.2** rows labeled: "% of students employed while attending the CC or TI" and "% of full-time earning potential" provide the percentage estimates of the students who held jobs (79%) while attending the college or institute, and how much they earned (77%) relative to full-time employment (or what they would statistically be earning if they did not attend college). The former is a simple percent estimate of the portion of the student body working full or part-time. The latter is a more complex estimate of their earnings relative to their earning power if they did not attend the college or institute (i.e., recognizing that several students may hold part-time jobs paying minimum wage while attending college).

Table 2.2. Student Body Profile

| | Values |
|---|---|
| Total headcount of unduplicated credit students | 123,879 |
| Total headcount of non-credit students | 118,113 |
| Total unduplicated enrollment, all campuses in province | 241,992 |
| % of students employed while attending the CC or TI | 79% |
| % of full-time earning potential | 77% |
| Students remaining in province after leaving the CC or TI | 75% |
| Attrition rate over time (leaving province) | 33% |
| "Settling In" factors (years): | |
| Completing Diploma | 2.0 |
| Completing Certificate | 0.5 |
| Non-completing transfer track | 2.5 |
| Non-completing workforce | 0.0 |
| ABE/ESL | 0.5 |

As indicated in the table, it is estimated that 75% of the students remain in the province (as defined in **Figure 1.1**) and thereby generate province-wide benefits. The remaining 25% leave the province altogether and are not counted as part of the economic development benefits. The 75% retention rate applies only to the first year, however. We assume that 33% of the students, and thus associated benefits, will leave the province over the next 30 years due to attrition (e.g., retirement, out-migration, or death).

The last five items in **Table 2.2** are *settling-in* factors—the time needed by students to settle into the careers that will characterize their working lives. These factors are adapted from Norton Grubb (June 1999). Settling-in factors have the effect of delaying the onset of the benefits to the students and to society at large.

[2] The opportunity cost is the measure of the earnings foregone; i.e., the earnings the individual would have collected had he or she not attended any of the 16 Alberta community colleges or technical institutes.



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## Entry-Level Education

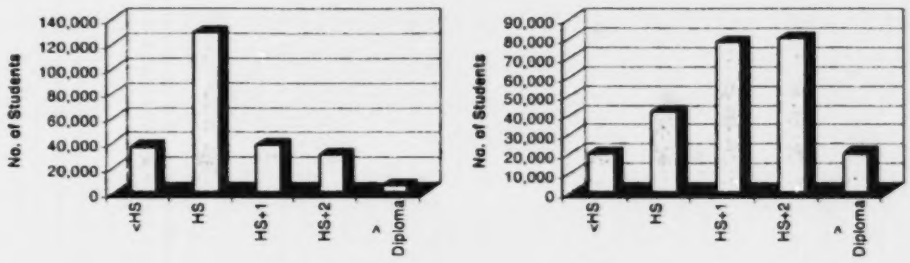
**Table 2.3** shows the education level and gender of the aggregate student body. This breakdown is used only to add precision to the analysis, not for purposes of comparing between different groups. Five education entry levels are indicated in approximate one-year increments, ranging from less than HS to post two-year diploma. These provide the platform upon which the economic benefits are computed.

The *entry level* characterizes the education level of the students when they first enter the colleges or institutes; this is consistent with the way most colleges keep their records. The analysis in this report, however, is based on the educational achievements of the students during the current year. As not all students reported in the enrollment figures for the fiscal year are in their first year of college, an adjustment was made to account for upper class students who had accumulated credits during their CC or TI experience and moved up from the HS equivalent category. For this reason, the education levels of the student body must also be estimated for the beginning of the analysis year. Thus, of the 61,917 males who first entered with HS equivalent, it is estimated that only 19,388 still remain in that category at the beginning of the analysis year, meaning that 42,529 students have actually moved up from the "HS equivalent" category to the "1 year post HS or less" category or beyond since they first entered the colleges or technical institutes. Note that the "Entry Level" and "Begin Year" columns always add to the same total. Differences between the two columns reflect a redistribution of students from entry level to where they are at the beginning of the analysis year. The assumptions underlying the process of redistributing the students from the "Entry Level" to "Begin Year" columns are internal to the economic model—they are designed to capture the dynamics of the educational progress as the students move up the educational ladder beyond their initial entry level.

Table 2.3. Education Entry Level of Student Body

| | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| Entry Level | Entry Level | Begin Year | Entry Level | Begin Year | Entry Level | Begin Year |
| < HS | 13,679 | 7,543 | 23,117 | 12,748 | 36,795 | 20,292 |
| HS equivalent | 61,917 | 19,388 | 67,836 | 22,719 | 129,753 | 42,108 |
| 1 year post HS or less | 16,840 | 35,952 | 21,934 | 42,358 | 38,774 | 78,310 |
| 2 years post HS or less | 12,727 | 35,851 | 17,655 | 44,711 | 30,382 | 80,563 |
| > Diploma | 2,363 | 8,790 | 3,925 | 11,930 | 6,287 | 20,720 |
| Total | 107,525 | 107,525 | 134,467 | 134,467 | 241,992 | 241,992 |

**Figure 2.2. Student Body Education Level: Entry vs. Beginning of Analysis Year**




## The Achievements

**Table 2.4** shows the student breakdown in terms of analysis year academic pursuits and/or achievements according to nine categories: 1) retirees who attend largely for self enrichment, 2) 4 year degree completers, 3) 2 year diploma completers, 4) 1 year certificate completers, 5) apprenticeship program completers, 6) apprenticeship program non-completers, 7) all transfer students, 8) all other credit and non-credit students, and 9) ABE/ESL students.[3]

As indicated in the table, students achieving their graduation goals would be those completing 4 year degrees, 2 year diplomas, certificates, or apprenticeship programs (0.3%, 5.3%, 4.5% and 2.2%, respectively). The majority of students are found in category 8, which consists of a mix of all other credit and non-credit students (63.3%) who either fulfill their educational needs, or return the following year to continue to work toward their goals. In addition to the non-completing apprenticeship program (5.4%) and the transfer students (6.6%), the retired (0.1%) and ABE/ESL students (12.3%) complete the breakdown of the student body. The retired students are simply backed out of the analysis altogether on the assumption that they do not attend the community colleges or technical institutes to acquire skills that will increase their earnings. ABE/ESL students are assumed to have a lower percentage impact than other students, because the end product of their education is to arrive at the "starting gate" on an equal basis with others. This does not mean that ABE/ESL education has lower value; it simply means that these students must complete an extra step before they can compete effectively in the job market and reap the benefits of higher earnings.

[3] ABE/ESL = Adult basic education and English as a second language

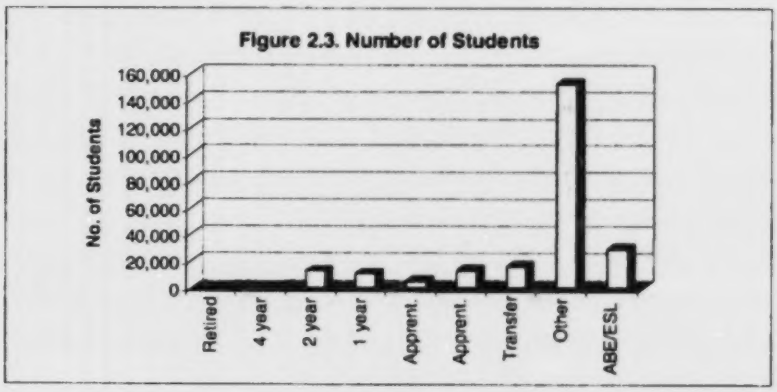
The fifth column shows the average age of the students generating the benefits (excluding retirees). The time horizon for the analysis is 37.4 years, which is the difference between the average age (27.6 years) and retirement age (65 years).

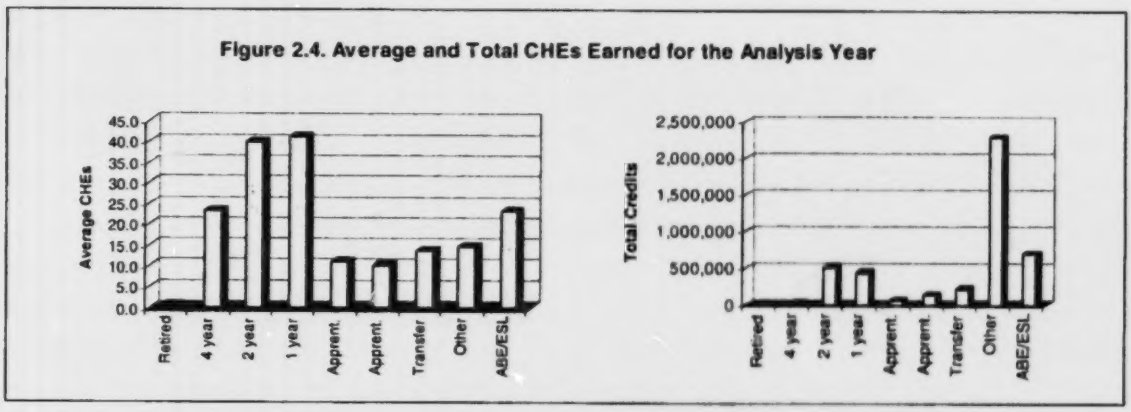
As indicated in Column 6, the average diploma and certificate student completed 40.2 and 41.4 CHEs of study, respectively, during the analysis year. The total number of CHEs completed during the year of analysis for the entire system student body is 4,380,392. Finally, the last column shows the average time the students are actually in residence on campus during the analysis year. This information is needed to determine the opportunity cost of their education.

Table 2.4. Levels of Achievement

| Student Body | Credit Students % | Headcount Credit | Headcount Non-Credit | Total Studs. 241,992 | Avg. Age | CHEs This Year | Total Credits | % Years Resid. |
|---|---|---|---|---|---|---|---|---|
| Retired Students | 0.1% | 98 | 179 | 278 | 68 | 0.8 | 212 | 0.03 |
| Students Completing 4 Year Degree | 0.3% | 819 | 0 | 819 | 31 | 23.2 | 18,996 | 0.77 |
| Students Completing 2 Year Diploma | 5.3% | 12,814 | 0 | 12,814 | 26 | 40.2 | 514,551 | 1.34 |
| Students Completing Certificate (1 year diploma) | 4.5% | 10,825 | 0 | 10,825 | 29 | 41.4 | 447,873 | 1.38 |
| Students Completing Apprenticeship Programs | 2.2% | 5,444 | 0 | 5,444 | 27 | 11.2 | 60,789 | 0.37 |
| Non-Completing Apprenticeship Program Students | 5.4% | 13,043 | 0 | 13,043 | 27 | 10.4 | 135,343 | 0.35 |
| Transfer Students | 6.6% | 16,023 | 0 | 16,023 | 23 | 13.9 | 222,249 | 0.46 |
| All Other Credit and Non-Credit Students | 63.3% | 54,288 | 98,782 | 153,070 | 28 | 14.9 | 2,287,360 | 0.50 |
| ABE/ESL Students | 12.3% | 10,525 | 19,152 | 29,678 | 28 | 23.4 | 693,017 | 0.78 |
| Total or weighted averages | 100.0% | 123,879 | 118,113 | 241,992 | 27.6 | 18.1 | 4,380,392 | |
| Credits required for one full-time year equivalent of study | | | | | | | 30 | |

Note: weighted average of CHEs per year does not include the retired students



## ANNUAL PRIVATE BENEFITS

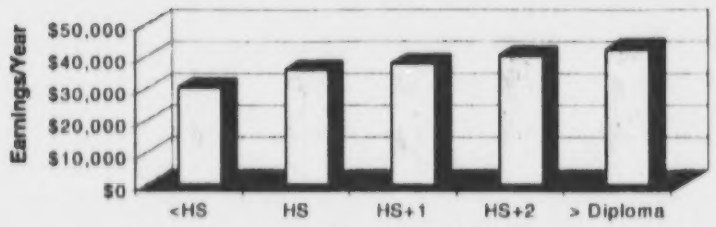
The earnings statistics in **Table 2.5,** on which the benefit estimates (reported in **Chapter 3** below) are based, reflect all occupations (technical and non-technical). The lower the education level, the lower the average earnings, regardless of the subject matters studied. The distinguishing feature among the achievement categories, therefore, is the number of CHEs completed. Statistics indicate that earnings are highly correlated with education, but correlation does not necessarily mean causation. Higher education is not the only factor explaining the private and public benefits reported in the statistics. Other variables such as ability, family background, and socioeconomic status play significant roles. The *simple correlation* between higher earnings and education nonetheless defines the *upper limit* of the effect measured. Our estimates of higher education's impact on earnings are based on a survey of recent econometric studies. A literature review by Chris Molitor and Duane Leigh (March, 2001) indicates that the upper limit benefits defined by correlation should be discounted by 10%. Absent any similar research for the social variables (health, crime, and social assistance and unemployment), we assume that the same discounting factor applies as well to the public benefits.

As education milestones are achieved, students move into higher levels of average earnings. **Table 2.5** shows average earnings by one-year education increments, linked to the gender profile of the Alberta CC and TI student body. The differences between the steps are indicated in the last column. We also assume that *all* education has value, and thereby attribute value to students completing less than full steps as well.

Table 2.5. Weighted Average Earnings

| Entry Level | Average Earnings | Diff. |
|---|---|---|
| 1 year short of HS | $30,353 | NA |
| HS equivalent | $35,951 | $5,599 |
| 1-year Certificate | $38,004 | $2,053 |
| 2-year Diploma | $40,397 | $2,393 |
| 1 year post Diploma | $42,582 | $2,185 |

Figure 2.5. Average Earnings by Education Levels




## Annual Public Benefits

Both students and society at large benefit from higher earnings. Indeed, the principal motivation for publicly funded higher education is to raise the productivity of the workforce and the incomes that the students will enjoy once they complete their studies. Society benefits in other ways as well. Higher education is associated with a variety of lifestyle changes that generate savings; e.g., reduced social assistance and unemployment, improved health, and reduced crime. Note that these are *external* or *incidental* benefits of education (see box). Colleges and technical institutes are created to provide education, not to reduce crime, social assistance and unemployment, or improve health. The fact that these incidental benefits occur and can be measured, however, is a bonus that enhances the economic attractiveness of CC and TI operations. It should not be taken to mean that taxpayers should channel more

**The Beekeeper Analogy**

The classic example of a positive externality (sometimes called "neighborhood effect") in economics is that of the private beekeeper. The beekeeper's only intention is to make money by selling honey. Like any other business, the beekeeper's receipts must at least cover his operating costs. If they don't, he will shut down.

But from society's standpoint there is more. Flower blossoms provide the raw input bees need for honey production, and smart beekeepers locate near flowering sources such as orchards. Nearby orchard owners, in turn, benefit as the bees spread the pollen necessary for orchard growth and fruit production. This is an uncompensated external benefit of beekeeping, and economists have long recognized that society might actually do well to subsidize positive externalities such as beekeeping.

CCs are in some ways like the beekeepers. Strictly speaking, their business is in providing education and raising the incomes of the young. Along the way, however, external benefits are created. Students' health and other lifestyles are improved, and society indirectly benefits from these just as orchard owners indirectly benefit from the location of beekeepers. Aiming at an optimal expenditure of public funds, the CCbenefits model tracks and accounts for many of these external benefits, and compares them to the public cost (what the taxpayers agree to pay) of CC education.



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money to colleges and technical institutes on the strength of these external benefits. Our purpose is simply to bring to the attention of education stakeholders that the activities of the 16 colleges and institutes in the Alberta system impact society in many more ways than simply the education they provide. In so doing, we have identified and measured some social benefits obviously related to educational achievements and included them in the mix of impacts generated by the colleges and technical institutes.

*Assuming provincial taxpayers represent the public*, the public benefits of higher education can be gauged from two perspectives, 1) a *broad* perspective that tallies all benefits, and 2) a *narrow* perspective that considers only changes in the revenues and expenditures of provincial government.

### Higher Earnings

**Broad Perspective**: Higher education begets higher earnings. The economy generates more income than it would without the CC and TI skills embodied in the labor force. From the broad taxpayer perspective, the total increase in earnings is counted as benefits of CC and TI education, adjusted down by the alternative education variable in **Table 2.9** (18.3%)—these students would still attend college elsewhere even if the community colleges and technical institutes were not present.

**Narrow Perspective**: Higher earnings translate into higher provincial *tax collections*. In the narrow taxpayer perspective we assume that the provincial authorities will collect 28.4% of the higher earnings in the form of taxes—the estimated composite of all taxes other than the federal income taxes.[4]

### Health Savings

The improved health of students generates savings in three measurable ways: 1) lower absenteeism from work, 2) reduced smoking, and 3) reduced alcohol abuse (**Table 2.6**). These variables are based on softer (i.e., less-documented) data. In general, statistics show a positive correlation between higher education and improved health habits. The table shows the calculated reductions in the incidences of smoking and alcohol abuse as a function of adding the higher education, also linked to the gender profile of the

[4] The tax data are obtained from Statistics Canada.

aggregate student body. Recall from above, the health savings are reduced by 10% in recognition of causation variables not yet identified.

**Broad Perspective**: The benefits from reduced absenteeism are equal to the average earnings per day multiplied by the number of days saved (less the students covered by the alternative education variable, as above). These are benefits that accrue largely to employers. Smoking and alcohol-related savings accrue mostly to the individuals who will *not* have to incur the health-related costs. In the broad taxpayer perspective, however, these benefits accrued to employers and individuals are also public benefits.

**Narrow Perspective**: Taxpayers benefit from reduced absenteeism to the extent that the provincial government is an employer. Accordingly, we assume a taxpayer's portion of absenteeism savings at 4.0%, equal to the estimated public portion of employment in the province.[5] As for smoking and alcohol-related savings, the taxpayers benefit to the extent that provincial health subsidies (to hospitals, for example) are reduced. We assume that 40% of the total benefits can be counted as taxpayer savings.[6]

Table 2.6. Reduced Absenteeism, Smoking and Alcohol Habits

| | Absenteeism | | Smoking | | Alcohol Abuse | |
|---|---|---|---|---|---|---|
| Education Level | Days | %/Year | Average | Reduction | Average | Reduction |
| < HS | 9.3 | 3.6% | 31.0% | NA | 6.7% | NA |
| HS equivalent | 7.8 | 3.0% | 25.1% | 19.0% | 6.2% | 8.6% |
| 1 year post HS or less | 7.1 | 2.7% | 22.2% | 11.4% | 5.6% | 8.4% |
| 2 years post HS or less | 6.3 | 2.4% | 19.1% | 14.1% | 4.9% | 13.2% |
| > Diploma | 5.9 | 2.3% | 17.7% | 7.6% | 4.5% | 8.6% |

1. Adrian, M.,1988. "Social Costs of Alcohol." Canadian Journal of Public Health, 79, September-October: 316-322.
2. Kaiserman, Murray J. "The Cost of Smoking in Canada." Chronic Diseases in Canada, 1991 Volume 18, No.1 – 1997, http://www.hc-sc.gc.ca/hpb/lcdc/publicat/cdic/cdic181/cdi81c_e.html.
3. Rehm, Jürgen, Lynda Robson, Eric Single, and Xiaodi Xie, and in collaboration with Jim Anderson, Bernard Choi, Sylvie Desjardins, and Rachel Moore. "The Costs of Substance Abuse in Canada." Canadian Centre on Substance Abuse, 75 Albert Street, Suite 300, Ottawa. http://www.ccsa.ca/docs/costhigh.htm.
4. Statistics Canada. "Days Lost Per Worker By Industry and Sex." CANSIM II, Table 279-0030, 2000.
5. Statistics Canada. "Injuries." Statistical Report on the Health of Canadians, prepared by the Federal Provincial and Territorial Advisory Committee on Population Health, Meetings of the Ministers of Health, p. 241-252, 1999.
6. Statistics Canada. "Lifestyle Behaviors, Drinking and Problem Drinking." Statistical Report on the Health of Canadians, prepared by the Federal Provincial and Territorial Advisory Committee on Population Health, Meetings of the Ministers of Health, p. 171-176, 1999.

[5] The ratio of provincial earnings over total earnings is obtained from Statistics Canada.
[6] The subsidy data are obtained from Statistics Canada, Canadian Institute for Health Information, "Healthcare in Canada" 82-222-xie



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**Figure 2.6. Days of Absenteeism by Education Levels**

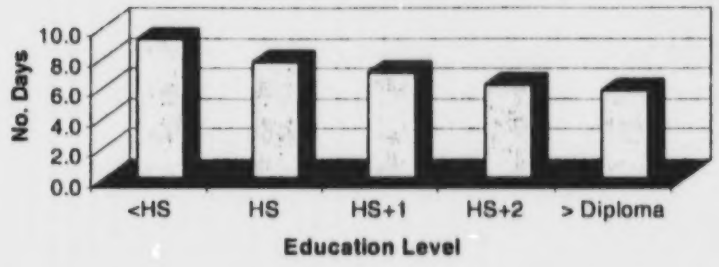



**Figure 2.7. Average Incidence of Smoking by Education Levels**

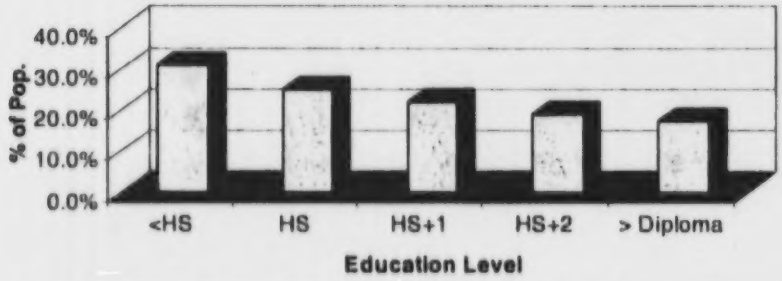
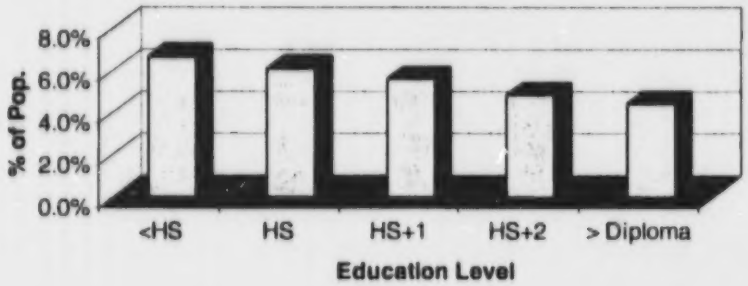



**Figure 2.8. Average Incidence of Alcohol Abuse**



## Crime Reduction Benefits

The first column of **Table 2.7** relates the probabilities of incarceration to education levels—incarceration drops on a sliding scale as education levels rise (linked to the gender profile of the aggregate student body). The percentage reductions are based on total prison population relative to the population at large. The implication is, as people achieve higher education levels, they are statistically less likely to commit crimes. The difference between before and after comprises the benefit attributable to education.

We identify three types of crime-related expenses: 1) incarceration expense, including the expense of prosecution, imprisonment, and reform, 2) victim costs, and 3) productivity lost as a result of time spent in jail or prison rather than working. As with our other social statistics, crime-related expenses are reduced by 10% in recognition of other causation factors.

**Broad Perspective**: From the broad taxpayer perspective, all reductions in crime-related expenses are counted as a benefit (less the students covered by the alternative education variable, as above).

**Narrow Perspective**: We assume that nearly all (80%) of the incarceration savings accrue to the provincial taxpayers—federal funding covers the remainder. Crime victim savings are avoided costs to the potential victims, not to the taxpayers. As such, we claim none of these as taxpayer savings. Finally, we apply our "composite" provincial government average tax rate (28.4%) to the added productivity of persons *not* incarcerated to arrive at the taxpayer benefits.

Table 2.7. Incarceration Rates

| Education Level | Average | Reduction |
|---|---|---|
| < HS | 0.3% | NA |
| HS equivalent | 0.2% | 15.5% |
| 1 year post HS or less | 0.2% | 8.8% |
| 2 years post HS or less | 0.2% | 10.7% |
| > Diploma | 0.2% | 5.6% |

1. CURE National, http://www.curenational.org/Position/curepo5.html. CURE National, P.O. Box 2310, Washington, DC 20013-2310, (202) 789-2126.

2. Statistics Canada. "A One-Day Snapshot of Inmates in Canada's Adult Correctional Facilities." Canadian Centre for Justice Statistics, 19th floor, R.H. Coats Building, Ottawa, Ontario K1A 0T6, ccjscsj@statcan.ca. Catagnhe No 85-601-XIE, March 1999.

3. Statistics Canada. "Crimes by Type of Offense." CANSIM II, Table 252-0001 and Catalogue No. 85-205-XIE.

4. Statistics Canada. "Injuries." Statistical Report on the Health of Canadians, prepared by the Federal Provincial and Territorial Advisory Committee on Population Health, Meetings of the Ministers of Health, p. 241-252, 1999.

5. Statistics Canada. "Population 15 years and Over by Highest Degree, Certificate or Diploma." Census Nation Tables, 1996 Census.



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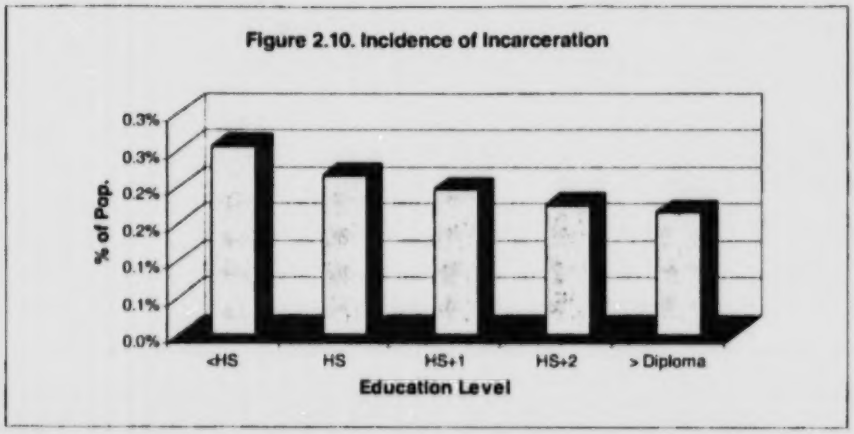


## Social Assistance and Unemployment Reduction Benefits

Higher education is statistically associated with lower social assistance and unemployment. **Table 2.8** relates the probabilities of individuals applying for social assistance and/or unemployment assistance to education levels (linked to the gender profile of the student bodies). As above, all social assistance and unemployment savings are reduced by 10% in recognition of other causation factors.

**Broad Perspective**: Reduced social assistance and unemployment claims are counted in full as benefits in the broad taxpayer perspective (less the students covered by the alternative education variable, as above).

Table 2.8. Social Assistance & Unemployment

| | Social Assistance | | Unemployment | |
|---|---|---|---|---|
| Education Level | Average | Reduction | Average | Reduction |
| < HS | 6.7% | NA | 7.9% | NA |
| HS equivalent | 5.2% | 23.0% | 5.9% | 25.9% |
| 1 year post HS or less | 4.4% | 14.4% | 4.9% | 16.9% |
| 2 years post HS or less | 3.6% | 18.6% | 3.8% | 22.4% |
| > Diploma | 3.2% | 10.6% | 3.3% | 13.4% |

1. "Profiles Of Welfare: Myths And Realities." A report by the National Council of Welfare, Spring 1998. http://www.ncwcnbes.net/htmdocument/reportprowelfare/repprowelfare.htm
2. Statistics Canada. "Employment and Unpaid Work." Statistical Report on the Health of Canadians, prepared by the Federal Provincial and Territorial Advisory Committee on Population Health, Meetings of the Ministers of Health, p. 44-48, 1999.
3. Statistics Canada, Marie Drolet and Rene Morissette. "To What Extent Are Canadians Exposed to Low Income?" No. 146, April, 2000.



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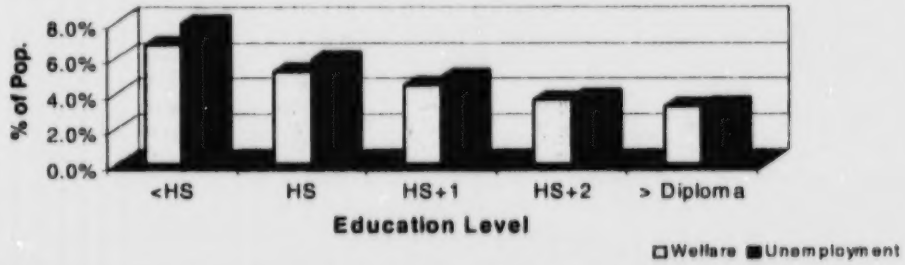
**Narrow Perspective**: Taxpayer benefits from reduced social assistance are limited to 26%--the extent to which the provincial taxpayers subsidize the social assistance system. None is claimed for unemployment, because most of these costs are borne by the Federal Government.[7]

**Figure 2.11. Welfare and Unemployment**




## Costs

There are two main cost components considered in the analytic framework: 1) the cost incurred by the student, including expenses for tuition and books, and the opportunity cost of his or her time (represented by the earnings foregone while attending college), and 2) the cost incurred by provincial government taxpayers, which is part of the CC and TI operating and capital costs (the budget—see **Table 2.1**). These are briefly discussed below.

### Opportunity Cost of Time

The opportunity cost of time is, by far, the largest cost. While attending college, most students forego some earnings, because they are not employed or are employed only part-time. The assumptions are discussed in conjunction with **Table 2.2** above. For the non-working students, the opportunity cost is the full measure of the incomes not earned during their attendance. For students working part-time, the opportunity cost is the difference between what they could make full-time less what they are making part-

[7] The social assistance subsidy data are obtained from Statistics Canada

time. No opportunity cost of time is charged for the fully employed. The opportunity costs are derived from the earnings categories by education entry levels given in **Table 2.5**, although with some important modifications, as briefly described below:

- The earnings in **Table 2.5** are averages based on trajectories of earnings for all ages, from 17 to 65 (roughly defining the time spent engaged in the workforce).
- The average earnings, therefore, define the mid-point of a working life trajectory that begins with low entry-level wages and culminates with a typical worker's highest wages around age 60.[8] The earnings data shown in **Table 2.5** are specific to the province of Alberta, weighted, however, to reflect the specific gender makeup of the aggregate student body.
- The opportunity cost of time is then conditioned by the average age of the student (27.6 years, see **Table 2.4**). In particular, the average earnings at the midpoint ($37,672 in **Table 3.5**) are adjusted downward to $22,964 to reflect the average earnings at age 27.6.

### The Budget

Beyond the student perspective, our assessment of the Alberta community colleges and technical institutes considers the benefits and costs from the provincial government taxpayer perspective. Accordingly, only the provincial government revenues in **Table 2.1** are included as costs in the investment and benefit-cost assessment. All else equal, the larger the other revenue sources in **Table 2.1** (federal grants, student tuition, and contract revenues) relative to provincial government revenues, the larger will be the relative economic payback to the taxpayers.

## Other Assumptions

**Table 2.9** lists several other assumptions imbedded in the analytic model: a) the discount rate and time horizon, b) crime-related costs (incarceration costs are inclusive of the cost per prison year plus all costs associated with arrest, investigation, trial and

[8] This profile of lifetime earnings is well documented in labor economics literature. For example, see Willis (1986), supported by the well-respected theoretical and empirical work of Becker (1964) and Mincer (1958).

finally incarceration),[9] c) social assistance and unemployment costs per year,[10] and d) health-related costs.[11] Annual real increases in costs are also included, although these are not used in the study. The alternative education opportunity assumption is discussed later in this chapter in association with the province-wide economic impacts.

Table 2.9. Miscellaneous Variables

| | Variables |
|---|---|
| Discount rate | 4.0% |
| Time horizon, years to retirement | 37.4 |
| Avg. cost/prison year (all incl.: arrest, trial, incarc., rehab. etc.) | $71,000 |
| Avg. length of incarc. (total years over 30-year time horizon) | 4.0 |
| Real cost increase per prison year | 0.0% |
| Average victim cost | $ 85,000 |
| Real victim cost increase per year | 0.0% |
| Average cost per year on social assistance | $ 65,740 |
| Avg. duration on welfare (total years over 30-year time horizon) | 4.0 |
| Social Assistance/unemployment cost increase per year | 0.0% |
| Average cost per unemployment year | $ 36,249 |
| Avg. duration on unempl. (total years over 30-year time horizon) | 4.0 |
| Smoking-related medical costs per year | $ 2,574 |
| Alcohol-related medical costs/year | $ 13,039 |
| Real medical cost increase per year | 0.0% |
| Alternative education opportunities | 18.3% |

Assumptions adapted from:

1. Adrian, M.,1988. "Social Costs of Alcohol." Canadian Journal of Public Health, 79, September-October: 316-322.

2. Kaiserman, Murray J. "The Cost of Smoking in Canada." Chronic Diseases in Canada, 1991 Volume 18, No.1 – 1997, http://www.hc-sc.gc.ca/hpb/lcdc/publicat/cdic/cdic181/cd181c_e.html.

3. Rehm, Jürgen, Lynda Robson, Eric Single, and Xiaodi Xie, and in collaboration with Jim Anderson, Bernard Choi, Sylvie Desjardins, and Rachel Moore. "The Costs of Substance Abuse in Canada." Canadian Centre on Substance Abuse, 75 Albert Street, Suite 300, Ottawa. http://www.ccsa.ca/docs/costhigh.htm.

4. Statistics Canada. "A One-Day Snapshot of Inmates in Canada's Adult Correctional Facilities." Canadian Centre for Justice Statistics, 19th floor, R.H. Coats Building, Ottawa, Ontario K1A 0T6, ccjsccsj@statcan.ca. Catagolue No 85-601-XIE, March 1999.

5. Statistics Canada. "Justice Spending." Catalogue no. 85-002-XIE.

[9] The cost per prisoner is estimated at $93,654 per year by dividing the cost of incarceration of adults ($2.947 billion) by the number of federal and province prisoners (31,467). These estimates are from 1999 and adjusted to year 2002 using the Canada Consumer Price Index. They were obtained from the Canadian Centre for Justice Statistics and Statistics Canada.

[10] As indicated in the table, we assume that the average duration on social assistance and unemployment is 4.0 and 4.0 years, respectively. This means that, over the next 30 years or so, the cumulative incidence of social assistance and/or unemployment will be spread evenly over the time horizon—it is not a consecutive period.

[11] The incarceration, health, social assistance and unemployment probability and cost variables are internal to the analytic model.



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## PROVINCE-WIDE ECONOMIC BENEFITS

In general, the province-wide economy is affected by the presence of the 16 community colleges and technical students in Alberta in two ways: from its day-to-day operations (including capital spending), and from students who enter the workforce with increased skills. Day-to-day operations of the colleges and institutes provide the *direct* jobs and earnings of the faculty and staff, and additional *indirect* jobs and earnings through the action of regional multiplier effects. At the same time, the presence of college-trained past and present students in the provincial workforce deepens the economy's stock of human capital, which attracts new industry and makes existing industry more productive.

Estimating these province-wide economic effects requires a number of interrelated models. Multiplier effects are obtained with an input-output (IO) model constructed for Alberta. Estimating the CC and TI operations effects requires an additional model that takes the CC and TI expenditures, deducts spending that leaks from the economy, and bridges what is left to the sectors of the IO model.

Estimating the skill-enhancing effect of past students on the province-wide economy entails five basic steps.

1. Estimate the number of past students still active in the province-wide workforce.

2. Adjust for alternative education opportunities.

3. Estimate the increased earnings of the students still active in the province-wide workforce.

4. Adjust the overall earnings estimated in step 2 to account for a collection of substitution effects. This provides an estimate of the direct increase in province-wide earnings.

5. Allocate the direct increase in province-wide earnings to affected economic sectors, and augment these to account for a collection of demand and supply-side multiplier effects.

The end results include estimates of the impact of past student skills and increased productivity on: a) the size of provincial industries, and b) the size of the overall province-wide economy.

This section is divided into a number of subsections. The first documents our estimation of day-to-day CC and TI operations effects followed by sections that detail the steps necessary to estimate the effect of past student skills on the province-wide economy.

### The Impact of the Operations of Alberta's 16 CCs and TIs

The first step in estimating the impact of the operations of Alberta's 16 colleges and institutes is to assemble data on their combined operating and capital expenditures. These data are assembled from college budgets and collected into the categories of **Table 2.10**. Column 1 simply shows the total dollar amount of spending. Columns 2 through 5 apportion that spending to in-province, and out-of-province vendors. The net provincial portion is derived in Column 6. Net provincial spending shown in Column 6 is fed into the province-wide IO model.[12]

The information on total spending required for Column 1 is generally readily available, though sorting specific items to the categories of the table can take some time. Information in Columns 2 through 5 is generally more problematic: hard data are scarce on the provincial/non-provincial split. In these cases, the staff members of the 16 Alberta community colleges and technical institutes were asked to use their best judgment.

The first row in **Table 2.10** shows salaries and wages. These *direct* earnings are part of the province's overall earnings by place-of-work: These appear later as "Direct Earnings of Faculty and Staff" in the table of findings, **Table 3.16**. Dollar values in **Table 2.10** Column 6, "Net In-Province Spending," are fed into the economic region IO model. The IO model provides an estimate of indirect effects, and these appear as "Indirect Earnings" in findings **Table 3.16**.

[12] **Table 2.10**, by itself, might provide useful information to local audiences—Chambers of Commerce, local business establishments, Rotary clubs, and the like. The table indicates that the colleges are "good neighbors" in the provincial community, evidenced by the fact that an estimated 85% of all college expenditures benefit provincial vendors ($756,747 / $891,199 = 85%).

Table 2.10. Profile of CC and TI Spending In and Out of Provincial Economy ($ Thousands)

| Spending Categories | Tot. Dollar Amount (1) | In-province % (2) | Out of province % (3) | % In-province Manufact. (4) | % Out-of province Manufact. (5) | Net In-province Spending (6) |
|---|---|---|---|---|---|---|
| Salaries and wages | $503,715 | 90% | 10% | | | $451,972 |
| Travel | $12,171 | 67% | 33% | | | $8,110 |
| Electricity and natural gas | $18,807 | 87% | 13% | | | $16,303 |
| Telephone | $3,918 | 88% | 12% | | | $3,432 |
| Building materials & gardening supplies | $2,218 | 91% | 9% | 42% | 58% | $2,014 |
| General merchandise stores | $94,395 | 64% | 36% | 30% | 70% | $60,660 |
| Eating & drinking | $6,185 | 81% | 19% | | | $5,037 |
| Maintenance & repair construction | $37,224 | 74% | 26% | | | $27,378 |
| New construction | $107,540 | 88% | 12% | | | $95,096 |
| Insurance | $3,282 | 63% | 37% | | | $2,088 |
| Legal services | $1,315 | 92% | 8% | | | $1,210 |
| Credit agencies | $2,307 | 81% | 19% | | | $1,862 |
| Canadian Postal service | $3,834 | 67% | 33% | | | $2,565 |
| Accounting, auditing & bookkeeping | $190 | 94% | 6% | | | $179 |
| Marketing | $9,158 | 87% | 13% | | | $7,923 |
| Other business services | $54,434 | 81% | 19% | | | $44,213 |
| Water supply & sewerage systems | $7,892 | 98% | 2% | | | $7,712 |
| Printing & publishing | $3,985 | 80% | 20% | | | $3,175 |
| Rental property | $8,079 | 93% | 7% | | | $7,544 |
| Services to buildings | $7,221 | 88% | 12% | | | $6,320 |
| Unemployment compensation | $1,863 | 34% | 66% | | | $624 |
| Honoraria + other payments to households | $1,466 | 92% | 8% | | | $1,348 |
| Total | $891,199 | | | | | $756,747 |

Note: this table provides details for the summary of the role of the CCs and TIs in the provincial economy (Table 3.16)

## Estimating CHEs Embodied in the Present-Day Workforce

This section describes the submodel for estimating the CHEs of past CC and TI instruction embodied in the present-day province-wide workforce. **Table 2.11** indicates variables critical to the model, while **Table 2.12** shows the various steps in the calculation. The various values appearing in **Table 2.11** originally appear (with citation) in **Table 2.2** and **Table 2.4**. Considering **Table 2.12** one column at a time reveals the steps involved in estimating embodied CHEs.

Column 1 provides an estimate of the enrollment history (unduplicated headcount) of the students enrolled in the 16 Alberta colleges and institutes. Column 2 represents the non-retired students, in other words, the students who have the potential to go into the workforce. Column 3 is the same as Column 2, but net of students who leave the province immediately upon leaving college. As shown in the table, 75% of the students remain in the province upon leaving the colleges or institutes, and 25% leave the province.



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Column 4 goes one step further—a comparison of Columns 3 and 4 indicates that all past students have left college except for the last three years (1998-2001) where students are still enrolled (the leaver assumptions are shown in Column 9).

Column 5 further reduces leavers to focus only on those who have settled into a somewhat permanent occupation. As shown in Column 10 (the "settling factor"), it is assumed that all students settle into permanent occupations by their fourth year out of school. Settling-in assumptions are specified in **Table 2.2** above.

Column 6 transitions further from leavers who have settled into jobs to leavers still active in the current workforce. Here we net off workers who, subsequent to leaving college and settling into the provincial workforce, have out-migrated, retired, or died. As shown in **Table 2.11**, 33% of the past students will out-migrate, retire or die over the course of the next 30 years. This "30-year attrition" follows an assumed logarithmic decay function shown in Column 11 labeled "active in local workforce."

Column 7 shows the average CHEs generated per year back to 1972. These data were obtained by dividing total year-by-year CHEs by the corresponding headcount.[13] Column 8 shows the product of the year-by-year average CHEs, and the estimate of the number of past students active in the current workforce in Column 6. Looking to the total in Column 8, we estimate that the current Alberta workforce embodies some 51.3 million CHEs of past CC and TI instruction.

Table 2.11. Critical Variables

| Assumptions | Values |
|---|---|
| Current headcount of students | 241,992 |
| Students remaining in province after leaving CC or TI | 75% |
| 30-year attrition | 33% |
| Decay rate | 1.4% |
| Overall average of credits earned per student this year | 18.1 |

[13] We used the current year estimate of CHEs (see **Table 2.4**), adjusted for the retired students, as a proxy for the average achievement per student in all prior years before FY 2001.

## Reducing the CHEs of Alberta's 16 CCs and TIs to Account for Alternative Education Opportunities

The 51.3 million CHEs of past instruction from the 16 Alberta colleges and institutes indicated in **Table 2.12** increase the skills embodied in the province-wide workforce and, through them, the overall size of the provincial economy in terms of earnings. Before turning to the income calculation, however, it is fair to ask to what degree past students would have been able to obtain schooling (and therefore skills) absent the CC and TI system in Alberta. This is the common "with and without condition" in applied economic analysis.

The IR staffs provided the estimate of the alternative education opportunity variable (18.3%) by taking into account opportunities such as private trade schools and colleges, public four-year institutions, correspondence schools, and so on. Accordingly, when calculating the net increase in regional income attributable to Alberta's 16 community colleges and technical institutes, the historic CHE's indicated in **Table 2.12** are reduced by 18.3%.

Table 2.12. Estimating Credit Hours of Instruction Embodied in the Workforce

| | | | | | | | | | Assumptions | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Student Enrollment Headcount | Subtract Retired Students | Subtract Students Migrating Immediately | Students who have left CCs/TIs (Leavers) | Leavers Who Have Settled Into Jobs | # Settled Into Jobs - Active in the Workforce | Average Credit Equivalents | Credits Embodied in the Workforce | % of Students in Workforce | Settling Factor | Active in Workforce |
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1972 | 58,847 | 58,779 | 44,175 | 44,175 | 44,175 | 29,451 | 18.12 | 533,690 | 100% | 100% | 66.7% |
| 1973 | 66,596 | 66,519 | 49,992 | 49,992 | 49,992 | 33,783 | 18.12 | 612,184 | 100% | 100% | 67.6% |
| 1974 | 73,244 | 73,160 | 54,982 | 54,982 | 54,982 | 37,661 | 18.12 | 682,461 | 100% | 100% | 68.5% |
| 1975 | 83,315 | 83,219 | 62,542 | 62,542 | 62,542 | 43,422 | 18.12 | 786,855 | 100% | 100% | 69.4% |
| 1976 | 95,102 | 94,993 | 71,390 | 71,390 | 71,390 | 50,239 | 18.12 | 910,398 | 100% | 100% | 70.4% |
| 1977 | 100,020 | 99,906 | 75,082 | 75,082 | 75,082 | 53,556 | 18.12 | 970,508 | 100% | 100% | 71.3% |
| 1978 | 112,844 | 112,715 | 84,709 | 84,709 | 84,709 | 61,245 | 18.12 | 1,109,836 | 100% | 100% | 72.3% |
| 1979 | 117,536 | 117,402 | 88,231 | 88,231 | 88,231 | 64,659 | 18.12 | 1,171,714 | 100% | 100% | 73.3% |
| 1980 | 122,746 | 122,605 | 92,142 | 92,142 | 92,142 | 68,444 | 18.12 | 1,240,295 | 100% | 100% | 74.3% |
| 1981 | 130,047 | 129,898 | 97,623 | 97,623 | 97,623 | 73,502 | 18.12 | 1,331,954 | 100% | 100% | 75.3% |
| 1982 | 137,419 | 137,261 | 103,156 | 103,156 | 103,156 | 78,725 | 18.12 | 1,426,601 | 100% | 100% | 76.3% |
| 1983 | 149,113 | 148,942 | 111,935 | 111,935 | 111,935 | 86,587 | 18.12 | 1,569,086 | 100% | 100% | 77.4% |
| 1984 | 149,129 | 148,958 | 111,947 | 111,947 | 111,947 | 87,774 | 18.12 | 1,590,581 | 100% | 100% | 78.4% |
| 1985 | 153,293 | 153,117 | 115,072 | 115,072 | 115,072 | 91,453 | 18.12 | 1,657,240 | 100% | 100% | 79.5% |
| 1986 | 158,932 | 158,749 | 119,305 | 119,305 | 119,305 | 96,107 | 18.12 | 1,741,580 | 100% | 100% | 80.6% |
| 1987 | 163,257 | 163,070 | 122,552 | 122,552 | 122,552 | 100,065 | 18.12 | 1,813,316 | 100% | 100% | 81.7% |
| 1988 | 168,063 | 167,870 | 126,160 | 126,160 | 126,160 | 104,413 | 18.12 | 1,892,094 | 100% | 100% | 82.8% |
| 1989 | 180,407 | 180,200 | 135,427 | 135,427 | 135,427 | 113,607 | 18.12 | 2,058,709 | 100% | 100% | 83.9% |
| 1990 | 185,068 | 184,856 | 138,925 | 138,925 | 138,925 | 118,128 | 18.12 | 2,140,625 | 100% | 100% | 85.0% |
| 1991 | 185,256 | 185,044 | 139,066 | 139,066 | 139,066 | 119,857 | 18.12 | 2,171,958 | 100% | 100% | 86.2% |
| 1992 | 185,766 | 185,553 | 139,449 | 139,449 | 139,449 | 121,822 | 18.12 | 2,207,570 | 100% | 100% | 87.4% |
| 1993 | 191,100 | 190,880 | 143,453 | 143,453 | 143,453 | 127,024 | 18.12 | 2,301,847 | 100% | 100% | 88.5% |
| 1994 | 187,357 | 187,143 | 140,644 | 140,644 | 140,644 | 126,231 | 18.12 | 2,287,479 | 100% | 100% | 89.8% |
| 1995 | 198,706 | 198,478 | 149,163 | 149,163 | 149,163 | 135,699 | 18.12 | 2,459,042 | 100% | 100% | 91.0% |
| 1996 | 204,507 | 204,273 | 153,518 | 153,518 | 153,518 | 141,561 | 18.12 | 2,565,272 | 100% | 100% | 92.2% |
| 1997 | 213,660 | 213,415 | 160,388 | 160,388 | 160,388 | 149,909 | 18.12 | 2,716,543 | 100% | 100% | 93.5% |
| 1998 | 226,351 | 226,091 | 169,915 | 169,915 | 169,915 | 160,974 | 18.12 | 2,917,057 | 100% | 100% | 94.7% |
| 1999 | 233,588 | 233,320 | 175,348 | 175,259 | 157,733 | 151,466 | 18.12 | 2,744,767 | 100% | 90% | 96.0% |
| 2000 | 239,561 | 239,287 | 179,832 | 175,786 | 131,839 | 128,324 | 18.12 | 2,325,390 | 98% | 75% | 97.3% |
| 2001 | 241,992 | 241,714 | 181,656 | 164,408 | 77,204 | 77,204 | 18.12 | 1,399,034 | 85% | 50% | 100.0% |
| Embodied Total | | | | | | | | 51,335,863 | | | |



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### From Embodied CHEs to Direct Province-wide Income Effects

In the standard model, province-wide income is expressed as a function of physical and human capital. Human capital is increased by adding new workers or by enhancing the skills of existing workers – the former adds the productivity of the new workers; the latter increases the productivity of existing workers. Increased human capital has a direct and indirect effect on *province-wide income*. The direct effect is conveyed in the higher earnings of the newly skilled workers themselves, while the indirect stems from associated multiplier effects. This section describes our process for estimating the direct effect.

A key part of the overall model is the "engine" that estimates the value per CHE of instruction.[14] The product of per-CHE added earnings, and the total of embodied past CC and TI instruction (51.3 million CHEs, **Table 2.12**) provides the dollar estimate of how much more past students are earning as a result of their coursework. The question is: how much of this added *personal* income can be counted as added *province-wide* income?

The answer to this question depends on the magnitude of certain elasticity assumptions at work in the province-wide income model. As shown in the text box, the elasticities can vary from perfectly inelastic to perfectly elastic. The text box describes the issue according to "two polar cases," one accepting all of the added student income, the other accepting none of it. Obviously the actual value will lie somewhere between. How much of increased past student income should be counted as increased regional income?

There is considerable empirical literature on the economic development effects of education, though mainly in the international rather than regional context. In a recent study, Bils and Klenow (2000) survey previous work on the subject and advance a model of their own. Based on their findings, we reduce the full past student income increase (the perfectly inelastic case) by 2/3 to arrive at our estimate of the net increase in province-wide income. This estimate for Alberta's 16 community colleges and technical institutes appears in **Table 3.16** under the heading "Earnings Attributable to Past Student Economic Development Effects," "Direct Earnings."

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[14] Briefly, the engine that estimates the value per CHE does so by combining earnings/education data from **Table 2.5** with information on aggregate student achievements during the analysis year (from **Table 2.4**). These calculations are discussed more fully in **Chapter 3**.

## The Industries where Past Students Work

Calculating the indirect impacts of workforce-embodied Alberta's 16 colleges and institutes skills also requires the use of the province-wide IO model discussed above. The model captures the extent to which a dollar spent turns over in the economy. We estimate indirect income effects by applying the IO multiplier to the direct effects. The use of IO multipliers in this way requires that the direct effects be disaggregated into specific industrial sectors. Disaggregating direct impacts avoids IO aggregation error,[15] and it facilitates an analysis of the contribution of the 16 Alberta colleges and institutes to the business sector – an analysis that appears in **Chapter 3**.

**Elasticity of Substitution: Two Polar Cases**

**Polar Case 1: Two Inelastic Assumptions.**

**Assumption #1:** *The rate of technical substitution between local skilled and unskilled workers is infinitely inelastic.* Skilled workers are able to perform tasks that unskilled workers cannot. Here, the added skills only increase value; they do not replace or substitute for existing production inputs. The added skills enable product line expansion, increased competitiveness of existing industry, and they attract new industry. Earnings and output expand as a result.

**Assumption #2:** *The rate of technical substitution between local and non-local workers is infinitely inelastic.* Skilled workers cannot be attracted from outside the province. Here, the existence of local skilled workers enables industry to do things they could not do otherwise. Locally skilled workers may attract new industry to the province (there is a near stand-alone development theory based on the notion that skilled workers attract new industry—Borts and Stein, 1964).

**Polar Case 2: Two Elastic Assumptions.**

**Assumption #1:** *The rate of technical substitution between local skilled and unskilled workers is infinitely elastic.* This implies that skilled workers are substituted for unskilled workers in a manner that creates no net additional regional earnings. Businesses simply replace lower productivity (and lower paid) unskilled workers with some smaller number of higher productivity (and higher paid) skilled workers, with no net change in overall output or earnings.

**Assumption #2:** *The rate of technical substitution between local and non-local workers is infinitely elastic.* Here existing or new industry can draw skilled workers from outside the province without extraordinary inducements or wage premiums that would otherwise increase costs and reduce competitiveness. Province-wide growth is driven by something other than local workforce skills. Hamilton et al., 1991, provides a broad discussion of the issues that work to limit the response of province-wide income to specified economic changes.

[15] Aggregation error occurs when a model with many industrial sectors is reduced through industry combination to a model with many fewer "aggregated industries" (see Miller and Blair, 1985, Chapter 5). Our initial estimate of past student direct earnings effects appears with no industry detail, and would thus require aggregating all industries to a single aggregate. By any measure, use of such an aggregated multiplier would court an unacceptable aggregation error. At the same time, our IO modeling system conveys industry detail at roughly the SIC 4-digit level. An assembly of data on direct past student effects at this fine level of detail is not realistic. Our solution is to disaggregate past student direct effects to the nineteen sectors appearing in **Table 2.13**.



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**Table 2.13** provides information on the sectoral distribution of jobs in the province-wide economy. The table provides a draft-stage vehicle for collecting information from Alberta's colleges and institutes on the sectoral breakdown of their past students, and it documents the information provided by the community college or technical institute. **Table 2.13** appears with four columns briefly described below.

Column 1 appears for reference and simply shows by sector the current distribution of *all jobs* in the provincial economy. For example, 3.0% of all province-wide jobs are in the Agriculture & Agricultural services sector, 4.6% of all jobs are in the Finance, Insurance and Real Estate sector, and so on. Column 2 shows the distribution by sector of *past students*, i.e., an estimate of the industries where they currently work. For example, while 3.0% of all province-wide jobs are in the Agriculture & Agricultural services sector, only 0.3% of past students are estimated to be in that sector. In contrast, while 4.6% of all jobs are in the Finance, Insurance and Real Estate sector, 9.0% of past students are estimated to be in that sector.

There is a long-standing theory of regional development known as *stage theory*. The notion is that regional economies develop by progressing from "low stage industries" (agriculture, mining, logging, etc.), to "higher stage industries" (process manufacturing, fabricative manufacturing), and finally to specialized finance, engineering, and so on. The distribution of past students shown in column 2 is derived mechanically, on the assumption that past students tend to find jobs in the higher development stage industries.[16]

In the course of assembling the data for our analysis, the 16 Alberta colleges and institutes have examined the distribution of past students as indicated in Column 2, and made any adjustments needed to accurately reflect the current realities. The revised distribution appears in Column 3.

Column 4 applies the distribution of student percentages in Column 3 to the total historic CHEs embodied in the workforce. This latter total is obtained from **Table 2.12**,

[16] Parr (1999) describes four stages of economic development: primary production, process manufacturing, fabricative manufacturing, and producer services and capital export. We apply a "development score" to Parr's stages: low scores for lower stage sectors and higher scores for higher development sectors. The scores are applied to employment in each sector, then normalized to form weights for distributing past students of Alberta's 16 community colleges and technical institutes students. The end result is that past students favor higher stage industries. For additional detail on the use of this approach for classifying industries by industrial stage see Robison and others, 2002.

and reappears at the bottom of Column 4 as the total. In **Chapter 3**, we estimate the contribution to student earnings per CHE of CC and TI instruction. This product provides our estimate of the direct effect of past CC and TI operations on regional earnings by industry.

### The Indirect Economic Development Effects of Students

The previous section described how we estimated the increment of province-wide earnings directly attributable to the CC and TI skills embodied in the current region workforce. Next, we turn to the indirect effects on both the demand and supply sides.

Consider first demand-side effects. Province-wide earnings are larger because of the skills embodied in past CC and TI students still active in the workforce. As earnings increase, so do industry outputs and industry purchases of inputs.[17] These in turn generate subsequent rounds of increased earnings, which are measured with the familiar multiplier effects. These indirect effects on the demand-side are estimated in the province-wide IO model by converting the embodied CHEs shown in **Table 2.13** into direct increased industry sales.

Second, consider the supply-side indirect effect. Economic development theory describes a process of "cumulative causation," or "agglomeration," whereby growth becomes in some degree self-perpetuating. The location of a new industry (A) in the province attracts other industries (B, C, and D) that use industry A's outputs as inputs. This, in turn, produces subsequent rounds of industry growth, and so on.[18] To estimate agglomeration effects, we configure our economic region IO model to provide a set of so-called supply-driven multipliers (see for example Miller and Blair, 1985). We estimate the supply-side effects by converting the embodied CHEs shown in **Table 2.13** into direct increased industry value added, and then apply these to the multipliers of the supply-driven province-wide IO model.[19]

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[17] For example, associated with the increased output and earnings is an increased demand for both consumer goods and services, and goods and services purchased by businesses as inputs. These in turn produce a set of province-wide economic multiplier effects. These are all captured and included as part of the demand-side indirect effects.

[18] For a more complete discussion of agglomeration and cumulative causation see Krugman (1999).

[19] Agglomeration effects are difficult to estimate. Our procedure assumes that so-called "supply-driven IO multiplier effects" capture the agglomeration effects. To increase the plausibility of this assumption, we apply only the direct effects associated with the industries in the highest stages of development.

Table 2.13. Estimating the Distribution of Past Students by Industrial Sectors of the Provincial Economy

| Industries | Distribution of All Jobs 1 | Provisional Distribution of Past Students 2 | Final Distribution of Past Students 3 | Distribution of Historic CHEs Embodied in Current Workforce 4 |
|---|---|---|---|---|
| Agriculture & Agricultural Services | 3.0% | 0.3% | 0.3% | 151,956 |
| Mining, Sand, and Gravel | 5.5% | 0.5% | 0.5% | 278,750 |
| Construction | 7.5% | 0.7% | 0.7% | 380,620 |
| Manufacturing: Food/Wood & Paper/Textiles | 3.4% | 1.7% | 1.7% | 852,745 |
| Manufacturing: Chemicals/Petroleum/Stone & Glass | 3.8% | 3.8% | 3.8% | 1,929,253 |
| Manufacturing: Computer & Electronic Equipment | 0.6% | 1.2% | 1.2% | 640,067 |
| Manufacturing: Other | 0.8% | 0.7% | 0.7% | 382,532 |
| Transportation | 5.6% | 2.8% | 2.8% | 1,415,649 |
| Public Utilities | 1.2% | 0.6% | 0.6% | 292,743 |
| Publishing & Communications | 3.2% | 6.3% | 6.3% | 3,246,061 |
| Trade | 17.3% | 17.1% | 17.1% | 8,795,476 |
| Finance, Insurance, and Real Estate | 4.6% | 9.0% | 9.0% | 4,632,044 |
| Motels & Eating/Drinking & Amusement/Recreation | 9.0% | 4.5% | 4.5% | 2,285,198 |
| Consumer Services | 2.5% | 1.2% | 1.2% | 629,499 |
| Business Services | 8.2% | 8.1% | 8.1% | 4,170,164 |
| Medical/Educational/Social services | 18.8% | 37.2% | 37.2% | 19,110,316 |
| Federal Government | 2.0% | 1.9% | 1.9% | 998,909 |
| Provincial Government | 3.3% | 2.2% | 2.2% | 1,143,680 |
| Total | 100.0% | 100.0% | 100.0% | 51,335,663 |


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# Chapter 3
# PRIVATE, PUBLIC AND PROVINCE-WIDE ECONOMIC BENEFITS

## INTRODUCTION

This chapter summarizes the main study results in four sections: 1) the aggregate annual private and public benefits; 2) these same benefits measured per CHE and per student; 3) future benefits expressed in terms of NPV, RR, and B/C ratio, and 4) the province-wide economic benefits.

## ANNUAL BENEFITS

### Higher Student Earnings

The annual benefits are summarized in **Tables 3.1** and **3.2**. We begin with earnings growth in **Table 3.1**. Last year, each student completed, on average, 18.1 CHEs at the 16 Alberta community colleges and technical institutes (see **Table 2.4**), only a fraction of one full year of study. This is because the majority of students attend for a variety of purposes as discussed in conjunction with **Table 2.4**; for some, to make progress towards an eventual degree, and for others, simply to acquire certain skills that will increase their productivity in the workforce. A total of 241,992 students will capture $269.4 million worth of higher annual earnings based on this average increase in educational attainment.

### Social Savings

#### *Health-Related Savings*

Also in **Table 3.1**, we see that improved health, lower social assistance and unemployment, and lower crime will result in annual dollar savings to the taxpayers of $39.8, $22.1, and $0.9 million (rounded). In **Table 3.2**, these same results are presented in greater detail—health-related absenteeism will decline by 109,811 days per year, translating to a total of 422 years' worth of productivity gained per year (based on 260 workdays per year). Annual total dollar savings from reduced absenteeism days equals

$15.9 million. There will be 4,509 fewer smokers and 943 fewer alcohol abusers, amounting to annual total dollar savings of $11.60 and $12.3 million.

### *Crime-Related Savings*

There will be 30 fewer people incarcerated as a result of the higher education obtained, saving the taxpayers a total of about $308,576 per year. The assumptions pertaining to these results are listed in **Table 2.9** in the previous chapter. They are based on an average duration of 4.0 years incarcerated at an average cost of $71,000 per year (inclusive of arrest, prosecution, incarceration, and rehabilitation).[20] Fewer people incarcerated means more people gainfully employed—this translates to $192,535 in additional annual earnings for the province. Victim costs will be reduced by $369,422 per year.

### *Social Assistance and Unemployment Savings*

There will be 1,184 and 1,574 fewer people on social assistance and unemployment, respectively, in the community. The corresponding total dollar savings for the provincial community amounts to $15,649,890 ($4,587,544 social assistance + $11,062,346 unemployment savings) for one year, assuming that the average time spent on social assistance and unemployment is 4.0 years (see **Table 2.9**) spread over a 30-year period.

### *Total Public Benefits*

All told, there will be $56.3 million in public savings per year in the community—the sum of all health, crime, and social assistance/unemployment benefits in **Table 3.2.**

Table 3.1 Student Body Achievements, Higher Earnings

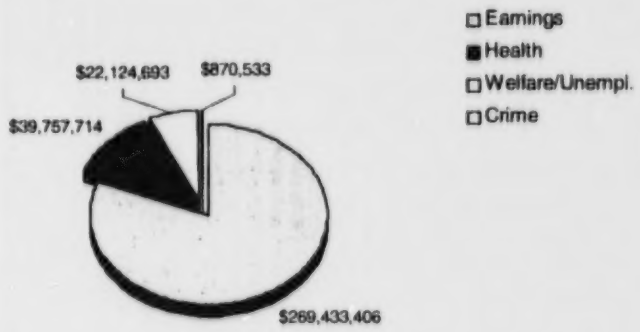
| | | Social (External Benefits) | | | |
|---|---|---|---|---|---|
| Level of Education | Higher Earnings | Improved Health | Lower Welfare Unemployment | Lower Crime | Total |
| < HS | $17,515,095 | $2,772,433 | $2,158,377 | $71,191 | $22,517,097 |
| HS equivalent | $24,431,702 | $1,755,586 | $1,151,623 | $38,700 | $27,377,611 |
| 1 year post HS or less | $90,701,909 | $18,649,085 | $10,683,443 | $430,073 | $120,464,511 |
| 2 years post HS or less | $86,384,529 | $10,732,910 | $5,363,191 | $221,068 | $102,701,699 |
| > Diploma | $50,400,171 | $5,847,700 | $2,768,058 | $109,500 | $59,125,429 |
| Total | $269,433,406 | $39,757,714 | $22,124,693 | $870,533 | $332,186,346 |

[20] The calculation is as follows: 30 not incarcerated x $71,000/4.0 years/37 years to retirement from **Table 2.9** = $14,218.

Table 3.2. Summary of Annual Benefits

| | Units | Earnings | Social Savings |
|---|---|---|---|
| **Higher earnings** | NA | $269,433,406 | |
| **Health benefits** | | | |
| Absenteeism savings (days) | 109,811 | NA | $15,864,904 |
| Fewer smokers, medical savings (# persons) | 4,509 | NA | $11,603,388 |
| Fewer alcohol abusers (# persons) | 943 | NA | $12,289,422 |
| **Crime benefits** | | | |
| Incarceration savings (# persons) | 30 | NA | $308,576 |
| Crime victim savings | NA | NA | $369,422 |
| Added productivity (fewer incarcerated) | NA | NA | $192,535 |
| **Social Assistance/Unemployment benefits** | | | |
| Social Assistance savings (# persons) | 1,184 | NA | $4,587,544 |
| Unemployment savings (# persons) | 1,574 | NA | $11,062,346 |
| Total | | $269,433,406 | $56,278,138 |

**Figure 3.1. Higher Earnings and Social Savings per Year**




## ANNUAL BENEFITS PER CHE AND PER STUDENT

The aggregate benefits reported in **Tables 3.1** and **3.2** above are expressed per CHE and per student in **Table 3.3**. On average, students capture: a) $67 per year in higher earnings per CHE,[21] and b) $1,150 per year in higher earnings per student on the basis of the number of CHEs completed. **Converted to a full-year-equivalent (30 CHEs), the annual earnings would amount to $1,904 per student**. On average, the social benefits

[21] Thus, a student attending for 10 CHEs will add $666 per year to the lifetime earnings. A longer curriculum will add substantially more. The earnings expectations are portrayed as linear but with many computational steps involved (see **Chapter 2**). The extrapolation is based on the averages of low earnings additions for leavers completing few CHEs, plus higher additions for leavers completing more CHEs.



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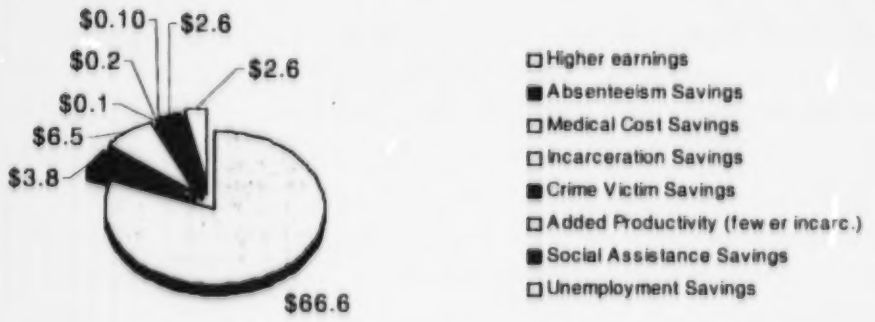
per CHE range from a low of $0 for Added Productivity (fewer incarcerated) to a high of $6 per CHE for Medical Cost Savings. On a per student basis, they range from a low of $2 per student for Added Productivity (fewer incarcerated) to a high of $111 for Medical Cost Savings. On a full-year equivalent basis (30 CHEs), the social savings would amount to $457 per student (the total of $2,362 less $1,904 of higher private earnings as indicated in **Table 3.3**).

Table 3.3. Annual $ per Credit and Student

| | Per Credit | Per Student | Annualized |
|---|---|---|---|
| Higher earnings | $67 | $1,150 | $1,904 |
| Absenteeism Savings | $4 | $66 | $110 |
| Medical Cost Savings | $6 | $111 | $184 |
| Incarceration Savings | $0 | $3 | $4 |
| Crime Victim Savings | $0 | $3 | $5 |
| Added Productivity (fewer incarc.) | $0 | $2 | $3 |
| Social Assistance Savings | $3 | $46 | $76 |
| Unemployment Savings | $3 | $46 | $76 |
| Total | $83 | $1,427 | $2,362 |

**Figure 3.2. Annual Benefits per Credit**



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## THE INVESTMENT ANALYSIS: INCORPORATING FUTURE BENEFITS

The results in **Tables 3.1** and **3.2** provide only a single-year snapshot of the benefits. As long as the students remain in the workforce, however, the skills that they acquire from the community colleges and technical institutes continue to add productivity over time. In the investment analysis, the higher earnings and avoided costs are projected into the future over the working life of the student, discounted to the present, and then compared to the present costs of education. The investment is feasible if all discounted future benefits are greater than or equal to the costs.[22]

The investment analysis results are shown in **Table 3.10** (in the aggregate, per CHE and per student). The end results sought are the **Net Present Value (NPV)**, **Rate of Return (RR)**, the **Benefit/Cost (B/C)** ratio and the **Payback Period**.[23] These are simply different ways of expressing the results. All of the present value results shown are intermediary steps that *ultimately generate* the NPVs, RRs and B/C ratios.

We begin with some definitions in **Table 3.4. Private** benefits are the higher earnings captured by the students themselves. **Broad taxpayer benefits** are the additions to earnings plus lower overall expenditures related to health, crime, social assistance, and unemployment. **Narrow taxpayer benefits** include increased provincial tax revenues (from increased incomes), and savings from reduced provincial government expenditures for incarceration, health and social assistance.

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[22] Future benefits are worth less than present benefits. The present value of $5,000 to be received 30 years from today is worth only $1,603 given a 4% discount rate ($5,000/$(1.04)^{30}$ = $1,603). If the same benefits occur each year for 30 years, each year's benefit must be discounted to the present, summed and collapsed into one value that represents the *cumulative* present value of all future benefits. Thus, the present value of 30-years' worth of $5,000 per year is $90,000.

[23] The criteria for feasibility: a) NPV must be positive or equal to zero; b) RR must be equal to or greater than the returns from other similar risk investments; c) the B/C ratio must be equal to or greater than 1; and d) the payback period is the number of years of benefits required to fully recover the investment made.

Table 3.4. Some Definitions

| Definitions | |
|---|---|
| **Student Benefits** | Higher earnings captured by the students |
| **Taxpayer Benefits: Broad** | Additions to earnings plus lower overall expenditures related to health, crime, social assistance and unemployment |
| **Taxpayer Benefits: Narrow** | Increased provincial govt. tax collections plus lower provincial govt. expenditures related to health, crime, social assistance & unemployment |
| **Student Costs** | Tuition (**Table 2.1**) + opportunity cost of time |
| **Taxpayer Costs** | Provincial Taxes, see Table 2.1 |
| **Results:** | |
| **Student Perspective** | Student Benefits / Student Costs |
| **Taxpayer Perspective: Broad** | Taxpayer Benefits (Broad) / Taxpayer Costs |
| **Taxpayer Perspective: Narrow** | Taxpayer Benefits (Narrow) / Taxpayer Costs |

On the cost side, student costs consist of the tuition paid by the students (22.8% of the total in **Table 2.1**) and, most importantly, the opportunity cost of time (the earnings foregone). Also included here are the other sources of institutional revenues from private sources (21.9%). The taxpayer costs consist of the provincial tax item in **Table 2.1**, or 54.2%.

The opportunity cost (earnings foregone) incurred by the student body in the aggregate is estimated in **Table 3.5**. The first number in the table is the overall average annual income of the student body (given gender characteristics). This number, however, reflects the midpoint of the lifetime trajectory of earnings, while what *is* needed are the earnings of the students while enrolled (which is expected to be less than earnings at the midpoint). This is the second number in the table, or $22,964 per year, assuming full-time employment. The adjustment from the first to the second number takes into account the average age of the student body and the relationship between earnings and age as specified by the well-known and tested "Mincer equation" (see, for example, Willis 1986, p 530).

We then deduct the retired student body (0.1%) to arrive at the net number of students subject to opportunity cost calculations— 241,714 students. The 51,235 not working are charged the full opportunity cost of time (based on the average term in residence), or $677,686,673. The 190,479 working students are charged only a fraction of the full opportunity cost (77%), or $587,750,342 as indicated in the table. Finally, we adjust the opportunity cost downward by the student aid grants and the estimated 10% adjustment for the restricted use of these grants for tuition and fees.

Table 3.5. Opportunity Costs (Earnings Foregone), $ per Year

| | | | Opp Cost |
|---|---|---|---|
| Avg. statistical annual income of given gender profile | | $37,672 | |
| Annual income at current age of students | | $22,964 | |
| CHEs per student (net of retired) | 17.3 | | |
| Avg. term in residence and avg. income while in residence | 58% | $13,227 | |
| Total number of students | | 241,992 | |
| Less retired % | 0.1% | 278 | |
| Remaining students subject to opportunity cost computation | | 241,714 | |
| Students not working while attending CC or TI and opportunity cost | 21% | 51,235 | $677,686,673 |
| No. of working students | | 190,479 | |
| % working part time, earnings relative to stat. averages, and opp. cost | 77% | $3,086 | $587,750,342 |
| Total opportunity cost | | | $1,265,437,015 |
| Other student aid | | $90,541,472 | |
| Restricted portion of student aid (tuition and fees) | 10% | $9,054,147 | ($81,487,325) |
| GRAND TOTAL STUDENT OPPORTUNITY COST | | | $1,183,949,690 |

We also present the results in different ways. First, the student perspective results indicate whether the education obtained at the Alberta colleges and institutes pays by comparing the private benefits (higher earnings) to the private costs. Second (as discussed in the previous chapter), we compare *all* private and public benefits to the public costs (the provincial taxpayer contributions in **Table 2.1**) in a **broad taxpayer perspective** in present value terms. Third and finally, in a **narrow taxpayer perspective**, we compare only a portion of the public benefits (taxpayer actual savings) to the public costs; i.e., do provincial taxpayer investments of $436,250,681 (**Table 2.1**) pay off in terms of the public savings generated?

### The Student Perspective

The collective investment of the students (time and money) is assessed in **Table 3.6.** Column 1 tracks the increased earnings of the student body as they leave the colleges or technical institutes, and follows them over the course of their assumed working lives (65 - 27.6 = 37 years, see **Table 2.4**). The upward trend in earnings mimics the Mincer equation (see Willis, 1986). It reflects both the growth in students' earnings over time and the spread in the increased earnings attributable to education.[24] Column 2 is simply Column 1 reduced by the 10% discount value that accounts for causation factors affecting student earnings. Column 3 shows the cost of the single year's education. Finally, Column 4 looks at the educational investment from a cash flow perspective, subtracting annual costs from the annual benefits.

[24] We computed a Mincer equation based on the estimated coefficients presented in Willis, 1986, p. 545. These were adjusted to 2001 dollars in the usual fashion by applying the "GDP Implicit Price Deflator."



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Table 3.6. Student Earnings ($ Thousands)

| Year | 1 Higher Earnings Gross | 2 Higher Earnings Net | 3 Cost | 4 Net Cash Flow |
|---|---|---|---|---|
| 1 | $92,340 | $83,106 | $1,530,168 | ($1,447,062) |
| 2 | $109,775 | $98,798 | $0 | $98,798 |
| 3 | $130,688 | $117,619 | $0 | $117,619 |
| 4 | $144,599 | $130,139 | $0 | $130,139 |
| 5 | $159,284 | $143,355 | $0 | $143,355 |
| 6 | $174,712 | $157,241 | $0 | $157,241 |
| 7 | $190,849 | $171,764 | $0 | $171,764 |
| 8 | $207,647 | $186,883 | $0 | $186,883 |
| 9 | $225,054 | $202,549 | $0 | $202,549 |
| 10 | $243,006 | $218,705 | $0 | $218,705 |
| 11 | $261,430 | $235,287 | $0 | $235,287 |
| 12 | $280,248 | $252,223 | $0 | $252,223 |
| 13 | $299,370 | $269,433 | $0 | $269,433 |
| 14 | $318,703 | $286,833 | $0 | $286,833 |
| 15 | $338,143 | $304,329 | $0 | $304,329 |
| 16 | $357,584 | $321,826 | $0 | $321,826 |
| 17 | $376,914 | $339,222 | $0 | $339,222 |
| 18 | $396,015 | $356,413 | $0 | $356,413 |
| 19 | $414,770 | $373,293 | $0 | $373,293 |
| 20 | $433,057 | $389,752 | $0 | $389,752 |
| 21 | $450,758 | $405,682 | $0 | $405,682 |
| 22 | $467,752 | $420,977 | $0 | $420,977 |
| 23 | $483,924 | $435,531 | $0 | $435,531 |
| 24 | $499,180 | $449,244 | $0 | $449,244 |
| 25 | $513,352 | $462,017 | $0 | $462,017 |
| 26 | $526,400 | $473,760 | $0 | $473,760 |
| 27 | $538,209 | $484,388 | $0 | $484,388 |
| 28 | $548,695 | $493,826 | $0 | $493,826 |
| 29 | $557,783 | $502,005 | $0 | $502,005 |
| 30 | $565,408 | $508,868 | $0 | $508,868 |
| 31 | $571,517 | $514,366 | $0 | $514,366 |
| 32 | $576,069 | $518,462 | $0 | $518,462 |
| 33 | $579,035 | $521,132 | $0 | $521,132 |
| 34 | $580,399 | $522,359 | $0 | $522,359 |
| 35 | $580,159 | $522,143 | $0 | $522,143 |
| 36 | $578,324 | $520,492 | $0 | $520,492 |
| 37 | $574,917 | $517,426 | $0 | $517,426 |
| 0 | $0 | $0 | $0 | $0 |
| 0 | $0 | $0 | $0 | $0 |
| NPV | | $5,533,594 | $1,471,315 | $4,062,278 |
| IRR | | | | 14.0% |
| B/C ratio | | | | 3.8 |
| Payback (years) | | | | 10.1 |

Does attending the 16 Alberta community colleges and technical institutes make economic sense for the students? The answer is a resounding **yes**. The future stream of benefits (higher earnings) accruing to the students has an NPV of $4,062,278 **(Table 3.6)**—a positive NPV (greater than zero) indicates that the investments made are strongly feasible. The B/C ratio of 3.8 is strongly positive since the ratio is well above 1. The RR of 14.0% is also well above the long-term rates of return obtainable in the stock or bond markets, and certainly above the 4.0% discount rate used in the analysis. In the long run, therefore, the average student will be substantially better off attending a

college or institute. The payback period for a student (tuition plus the earnings foregone) is 10.1 years—the higher earnings received beyond that period are pure economic rent—or a persistent earnings flow over and beyond the initial investments.

### The Broad Taxpayer Perspective

**Table 3.7** assesses one year's operation of the community colleges and technical institutes from the broad taxpayer perspective. The taxpayers must weigh requests for funding against the myriad other public needs. As such, they need information to better allocate increasingly scarce resources between alternative and competing ends. Column 1 shows the stream of total benefits, including increased earnings, and social savings from reduced spending on incarceration, health, social assistance and unemployment. Specifics on the estimation of values in Column 1 are presented in **Volume 2: Detailed Results, Table 19**. Column 2 adjusts for the 18% alternative education opportunity assumption (the percentage of the student body able to avail themselves of similar education elsewhere, absent the Alberta colleges and institutes). Column 3 is simply Column 1 less Column 2. Column 4 shows the provincial taxpayer cost for a single year, as reflected in provincial tax items in **Table 2.1**. Finally, Column 5 considers the broad perspective on the taxpayer's investment in a cash flow sense, subtracting annual costs from annual benefits.

The NPV given this broad perspective is $3,327 million and the B/C ratio is 8.9. More succinctly, every dollar of tax monies spent on CC and TI education will generate a total of $8.93 worth of social savings.[25]

[25]A word of caution—the RR approach sometimes generates percentage results that defy the imagination. Technically, the approach requires at least one negative cash flow (tuition plus opportunity cost of time) to offset all subsequent positive flows. A very high percentage return may be technically correct, but perhaps not consistent with conventional understanding of returns expressed as percentages. For purposes of the reports prepared for all colleges in the province-wide system, therefore, we express all RR results as: "NA" (particularly for the broad taxpayer perspective where high returns are expected). Only the B/C ratio is reported for the broad taxpayer perspective.

Table 3.7 Taxpayer Perspective: Broad ($ Thousands)

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Year | All Benefits | Benefits from Alt. Ed. Opportunities | Net Benefits | Total Taxpayer Costs | Less CC/TI Income Cash Flow |
| 1 | $877,149 | $18,745 | $858,404 | $436,251 | $422,153 |
| 2 | $110,365 | $20,203 | $90,162 | $0 | $90,162 |
| 3 | $119,919 | $21,952 | $97,967 | $0 | $97,967 |
| 4 | $125,906 | $23,048 | $102,857 | $0 | $102,857 |
| 5 | $132,172 | $24,195 | $107,977 | $0 | $107,977 |
| 6 | $138,697 | $25,390 | $113,307 | $0 | $113,307 |
| 7 | $145,456 | $26,627 | $118,829 | $0 | $118,829 |
| 8 | $152,422 | $27,902 | $124,520 | $0 | $124,520 |
| 9 | $159,584 | $29,210 | $130,354 | $0 | $130,354 |
| 10 | $166,845 | $30,543 | $136,303 | $0 | $136,303 |
| 11 | $174,230 | $31,894 | $142,335 | $0 | $142,335 |
| 12 | $181,677 | $33,258 | $148,419 | $0 | $148,419 |
| 13 | $189,144 | $34,625 | $154,519 | $0 | $154,519 |
| 14 | $196,586 | $35,987 | $160,599 | $0 | $160,599 |
| 15 | $203,955 | $37,336 | $166,619 | $0 | $166,619 |
| 16 | $211,206 | $38,663 | $172,543 | $0 | $172,543 |
| 17 | $218,288 | $39,960 | $178,328 | $0 | $178,328 |
| 18 | $225,154 | $41,217 | $183,937 | $0 | $183,937 |
| 19 | $231,755 | $42,425 | $189,330 | $0 | $189,330 |
| 20 | $238,043 | $43,576 | $194,467 | $0 | $194,467 |
| 21 | $243,973 | $44,662 | $199,312 | $0 | $199,312 |
| 22 | $249,501 | $45,673 | $203,827 | $0 | $203,827 |
| 23 | $254,584 | $46,604 | $207,980 | $0 | $207,980 |
| 24 | $259,185 | $47,446 | $211,739 | $0 | $211,739 |
| 25 | $263,269 | $48,194 | $215,075 | $0 | $215,075 |
| 26 | $266,802 | $48,841 | $217,962 | $0 | $217,962 |
| 27 | $269,760 | $49,382 | $220,378 | $0 | $220,378 |
| 28 | $272,119 | $49,814 | $222,305 | $0 | $222,305 |
| 29 | $273,861 | $50,133 | $223,728 | $0 | $223,728 |
| 30 | $274,973 | $50,336 | $224,637 | $0 | $224,637 |
| 31 | $275,449 | $50,424 | $225,026 | $0 | $225,026 |
| 32 | $275,285 | $50,394 | $224,892 | $0 | $224,892 |
| 33 | $274,485 | $50,247 | $224,238 | $0 | $224,238 |
| 34 | $273,055 | $49,985 | $223,070 | $0 | $223,070 |
| 35 | $271,010 | $49,611 | $221,399 | $0 | $221,399 |
| 36 | $268,366 | $49,127 | $219,239 | $0 | $219,239 |
| 37 | $265,146 | $48,537 | $216,608 | $0 | $216,608 |
| 0 | $0 | $0 | $0 | $0 | $0 |
| 0 | $0 | $0 | $0 | $0 | $0 |
| NPV | | | $3,745,981 | $419,472 | $3,326,510 |
| IRR | | | | | NA |
| B/C ratio | | | | | 8.9 |
| Payback (years) | | | | | NA |

## The Narrow Taxpayer Perspective

**Table 3.8** provides an investment analysis of the Alberta colleges and institutes from the narrow taxpayer perspective. Recall from **Chapter 2** that the narrow perspective considers only monies that actually appear on the books of provincial governments: revenue items such as tax receipts, and expenditure items such as road, bridge and street maintenance, police, public libraries and hospitals, jails and prisons, social assistance payments, and so on.

**Table 3.8**, Column 1 shows additions to provincial government revenues stemming from the operation of the Alberta community colleges and technical institutes during the single analysis year. The values in Column 1 are computed by applying average provincial government tax rates to the net increase in province-wide income attributed to the Alberta CC and TI system.[26] Also included in Column 1 are reductions (entered as negatives) in provincial government expenditures on crime, social assistance, unemployment and health. Projected dollar amounts in Column 1 are thus the sum of additional taxes collected, plus associated tax dollars saved as a result of the education provided by the colleges and institutes during the single analysis year.

Column 2 is simply the provincial government expenditure in support of the colleges and institutes for the analysis year, a value obtained directly from **Table 2.1**. Finally, Column 3 subtracts provincial government cost (Column 2) from benefits (Column 1), thereby providing the temporal cash flow needed for the investment analysis. As shown at the bottom of the table, the colleges and technical institutes provide the provincial government with an aggregate annual return of $586.5 million expressed as a net present value on its one year investment. Alternatively, the one year investment generates a 16.4% RR and a B/C ratio of 2.4, both indicating that the investment is attractive. The payback period is 8.1 years.

The returns shown in **Table 3.8** would be attractive even in the private sector, and they are very attractive in the public sector. Recall that the public sector generally undertakes those activities the private sector finds unprofitable, i.e., investments that generate book revenues insufficient to cover book costs, thus requiring taxpayer subsidy. For example, provincial governments fund the operation and maintenance of provincial parks at a substantial loss, collecting revenues in the form of camping and entrance fees that cover only a fraction of costs. Taxpayers are willing to subsidize parks because they perceive off-budget benefits, e.g., access to the outdoors, local development effects, environmental protection, and so on, that justify the budgetary losses. Note that this broader collection of off-budget benefits would normally be captured in the broad taxpayer perspective.

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[26] Increased income includes a portion of direct student earnings, salaries and wages at the colleges during the single analysis year, and an additional increment aimed at a collection of backward and forward multiplier effects.

Table 3.8. Taxpayer Perspective: Narrow ($ Thousands)

| Year | 1 Total Taxpayer Benefits | 2 Benefits from Alt. Ed Opportunities | 3 Net Taxpayer Benefits | 4 Total Taxpayer Costs | 5 Net Cash Flow |
|---|---|---|---|---|---|
| 1 | $245,115 | $2,521 | $242,594 | $436,251 | ($193,657) |
| 2 | $27,096 | $4,960 | $22,136 | $0 | $22,136 |
| 3 | $29,844 | $5,463 | $24,381 | $0 | $24,381 |
| 4 | $31,578 | $5,781 | $25,798 | $0 | $25,798 |
| 5 | $33,392 | $6,113 | $27,279 | $0 | $27,279 |
| 6 | $35,278 | $6,458 | $28,820 | $0 | $28,820 |
| 7 | $37,231 | $6,816 | $30,416 | $0 | $30,416 |
| 8 | $39,243 | $7,184 | $32,059 | $0 | $32,059 |
| 9 | $41,304 | $7,561 | $33,743 | $0 | $33,743 |
| 10 | $43,404 | $7,946 | $35,459 | $0 | $35,459 |
| 11 | $45,534 | $8,335 | $37,199 | $0 | $37,199 |
| 12 | $47,681 | $8,728 | $38,953 | $0 | $38,953 |
| 13 | $49,834 | $9,123 | $40,711 | $0 | $40,711 |
| 14 | $51,979 | $9,515 | $42,464 | $0 | $42,464 |
| 15 | $54,103 | $9,904 | $44,199 | $0 | $44,199 |
| 16 | $56,194 | $10,287 | $45,907 | $0 | $45,907 |
| 17 | $58,236 | $10,661 | $47,575 | $0 | $47,575 |
| 18 | $60,216 | $11,023 | $49,193 | $0 | $49,193 |
| 19 | $62,121 | $11,372 | $50,749 | $0 | $50,749 |
| 20 | $63,937 | $11,704 | $52,233 | $0 | $52,233 |
| 21 | $65,651 | $12,018 | $53,633 | $0 | $53,633 |
| 22 | $67,250 | $12,311 | $54,939 | $0 | $54,939 |
| 23 | $68,722 | $12,580 | $56,142 | $0 | $56,142 |
| 24 | $70,057 | $12,825 | $57,232 | $0 | $57,232 |
| 25 | $71,245 | $13,042 | $58,203 | $0 | $58,203 |
| 26 | $72,276 | $13,231 | $59,045 | $0 | $59,045 |
| 27 | $73,143 | $13,389 | $59,753 | $0 | $59,753 |
| 28 | $73,839 | $13,517 | $60,322 | $0 | $60,322 |
| 29 | $74,360 | $13,612 | $60,748 | $0 | $60,748 |
| 30 | $74,702 | $13,675 | $61,027 | $0 | $61,027 |
| 31 | $74,862 | $13,704 | $61,158 | $0 | $61,158 |
| 32 | $74,840 | $13,700 | $61,140 | $0 | $61,140 |
| 33 | $74,637 | $13,663 | $60,974 | $0 | $60,974 |
| 34 | $74,255 | $13,593 | $60,662 | $0 | $60,662 |
| 35 | $73,698 | $13,491 | $60,207 | $0 | $60,207 |
| 36 | $72,970 | $13,358 | $59,612 | $0 | $59,612 |
| 37 | $72,078 | $13,195 | $58,884 | $0 | $58,884 |
| 0 | $0 | $0 | $0 | $0 | $0 |
| 0 | $0 | $0 | $0 | $0 | $0 |
| NPV | | | $1,005,932 | $419,472 | $586,460 |
| IRR | | | | | 16.4% |
| B/C ratio | | | | | 2.4 |
| Payback (years) | | | | | 8.1 |

Investments in public education are usually viewed in the same way as investments in parks and other publicly subsidized activities, i.e., activities that generate losses from a narrow investment perspective but are justified by net benefits from a broad investment perspective. As shown in **Table 3.8,** however, Alberta's 16 community colleges and technical institutes are a notable exception to this general net-subsidy rule. The narrow perspective rate of return is strongly positive, and thereby indicates that the taxpayers' investments in the community college or technical institute generate increased public revenues and reduced expenditures that actually exceed the subsidy by taxpayers. **The practical effect of this is the following: if the investments made in the Alberta community colleges and technical institutes were reduced, taxes would have to be**

**raised in order for provincial governments to continue their support of other activities at current levels. The taxpayer investments of 54% of the total revenues (Table 2.1), in effect, subsidize other sectors of the economy that also receive taxpayer support. The simple bottom line from the narrow taxpayer perspective is that benefits accruing to the taxpayers far outweigh the relatively low investments they make in the community colleges and technical insitutes.**

### With and Without Social Benefits

In **Chapter 2** the social benefits attributable to CC and TI education (reduced crime, social assistance and unemployment, and improved health) were defined as *external benefits*, incidental to the operations of the college or institute. Community colleges and technical institutes do not directly aim at creating these benefits. Some would question the legitimacy of including these benefits in the calculation of the rates of return to higher education, arguing that only the direct benefits—the higher earnings—should be counted. **Tables 3.7** and **3.8** are both inclusive of the social benefits reported here as attributable to the college or institute. Recognizing the other point of view, **Table 3.9** shows the rates of return for both the broad and narrow perspectives exclusive of the social benefits. As indicated, the returns are still well above the threshold values (a B/C ratio greater than 1) confirming that the taxpayers receive great value from investing in Alberta's 16 colleges and technical institutes.

### Summary

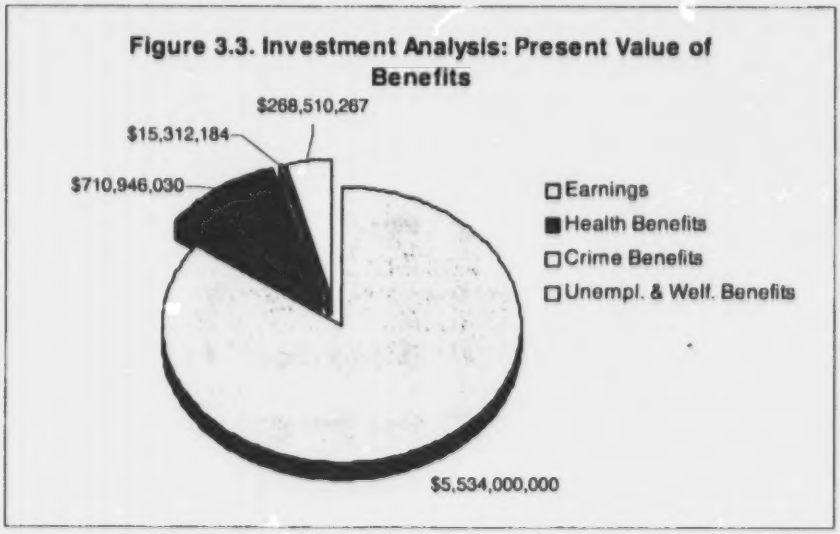
A summary of the investment analysis results (also reported in **Tables 3.6 – 3.8** above) is provided in **Table 3.10,** on aggregate, per CHE, and per student bases.

Table 3.9. Taxpayer Perspective ($ Thousands)

| | Broad Perspective With Social Savings | | Narrow Perspective With Social Savings | |
|---|---|---|---|---|
| | Included | Excluded | Included | Excluded |
| NPV | $3,326,510 | $2,513,843 | $586,460 | $414,679 |
| IRR | NA | NA | 16.4% | 12.2% |
| B/C ratio | 8.9 | 7.0 | 2.4 | 2.0 |
| Payback (years) | NA | NA | 8.1 | 11.0 |

Table 3.10. Benefit - Cost Summary

| | Aggregate | Per Credit | Per Student |
|---|---|---|---|
| PV of student benefits, increased earnings | $ 5,534,000,000 | $1,263 | $ 22,869 |
| Health benefits, captured by society | | | |
| PV of absenteeism savings | $ 285,983,437 | $65 | $ 1,182 |
| PV of tobacco and alcohol abuse medical savings | $ 424,962,593 | $97 | $ 1,756 |
| Crime | | | |
| PV of reduced incarceration | $ 5,488,399 | $1 | $ 23 |
| PV of reduced victim costs | $ 6,570,619 | $2 | $ 27 |
| PV of earnings (opportunity gained) | $ 3,253,166 | $1 | $ 13 |
| Social Assistance and Unemployment | | | |
| PV of reduced welfare rolls | $ 81,595,034 | $19 | $ 337 |
| PV of reduced unemployment | $ 186,915,233 | $43 | $ 772 |
| Sum of all present values, benefits | $ 6,528,768,481 | $ 1,490 | $ 26,979 |
| PV of all costs | | | |
| PV of provincial contribution to CC or TI budget | $ 436,250,681 | $100 | $ 1,803 |
| PV of opportunity cost of education + tuition | $ 1,530,168,000 | $349 | $ 6,323 |
| Sum of all present values, costs | $ 1,966,418,681 | $ 449 | $ 8,126 |
| NPV, Student Perspective | | $4,062,278 | |
| RR, Student Perspective | | 14% | |
| B/C Ratio, Student Perspective | | 3.8 | |
| Payback Period, Student Perspective | | 10.1 | |
| NPV, Taxpayer Perspective: Broad | | $3,326,510 | |
| RR, Taxpayer Perspective: Broad | | NA | |
| B/C Ratio, Taxpayer Perspective: Broad | | 8.9 | |
| Payback Period, Taxpayer Perspective: Broad | | NA | |
| NPV, Taxpayer Perspective: Narrow | | $586,460 | |
| RR, Taxpayer Perspective: Narrow | | 16.4% | |
| B/C Ratio, Taxpayer Perspective: Narrow | | 2.4 | |
| Payback Period, Taxpayer Perspective: Narrow | | 10.0 | |



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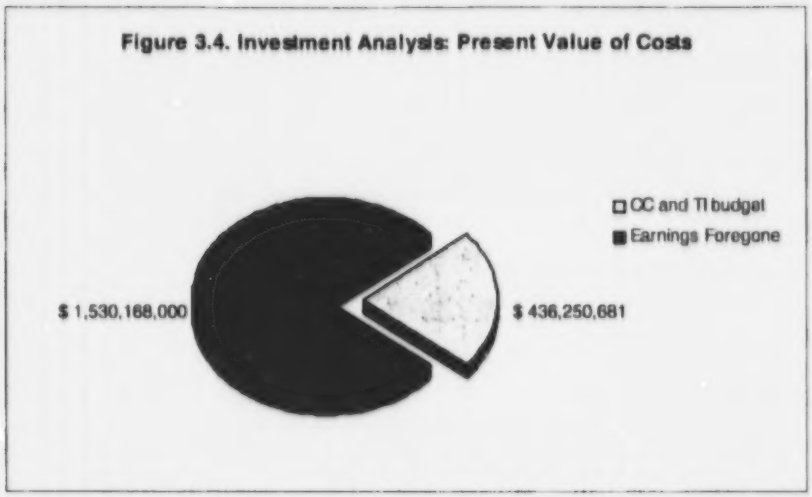


## PROVINCE-WIDE ECONOMIC BENEFITS

The 16 Alberta community colleges and technical institutes play an important role in the resiliency, growth and development of the provincial economy. In 2001, Alberta generated overall earnings (wages, salaries and proprietors' income) equal to $48.70 billion. The portion of this total credited to the existence of the 16 Alberta community colleges and technical institutes is discussed in the four subsections below, both in the aggregate and with industry detail. The industry-specific analysis highlights the contribution of Alberta's colleges and institutes to the local business community.

We begin with the day-to-day operating and capital expenditures of the colleges and technical institutes. These are fed into the regional IO model to estimate the earnings impacts generated by industry. Next, we consider the value of workforce-embodied CHEs to the earnings of past students of, and then estimate the net portion that can be counted as increased regional income—the *direct impact* of past instruction at Alberta's colleges and institutes. In the third section we utilize the multipliers of the regional IO model and estimate the *indirect impact* of past CC and TI instruction on province-wide earnings. In the fourth and final subsection we combine the three separate effects, 1) CC and TI operations and capital spending effects, 2) past CC and TI student direct effects, and 3) past CC and TI student indirect effects, to arrive at the overall aggregate effect of Alberta's 16 community colleges and technical institutes on earnings in the province.

## Earnings Linked to the Operation and Capital Spending of Alberta's 16 CCs and TIs

**Table 2.10** in **Chapter 2** shows the operating and capital spending of the 16 Alberta colleges and institutes during the analysis year. The last column (Column 6) of that table shows how much of the overall spending is captured by provincial vendors and other suppliers, i.e., the portion that stays in the provincial economy. The values in Column 6 are applied to the Alberta IO model to estimate the associated multiplier effects.

**Table 3.11** shows the results of the IO multiplier analysis of the operating and capital spending of Alberta's colleges and institutes. Column 1 is for reference, showing 2001 total earnings by industry. Column 2 shows the portion of total earnings explained by (or accounted for by) CC and TI spending, and Column 3 shows CC and TI-linked earnings as a percentage of total earnings by industry. For example, the construction sector in the Alberta had $3.51 billion in total earnings in 2001. Of this, CC and TI spending accounts for $41.84 million (or 1.2%). Similarly, the business-services sector (services to buildings, advertising, reproduction, legal and accounting services, etc.) had $4.25 billion in total earnings in 2001, of which $29.61 million (or 0.7%) was explained by the CC and TI spending. All told, the spending of Alberta's 16 community colleges and technical institutes explained $673.70 million, or 1.4% of all province-wide earnings in 2001.

Table 3.11. Earnings Linked to CC and TI Operations Expenditures

| | Earnings | | |
|---|---|---|---|
| | Baseline | Linked to CCs and TIs | % Linked to CCs and TIs |
| | ($1,000) | | |
| Industries | 1 | 2 | 3 |
| Agriculture & Agricultural Services | $854,708 | $1,009 | 0.1% |
| Mining, Sand, and Gravel | $4,873,235 | $850 | 0.0% |
| Construction | $3,507,260 | $41,840 | 1.2% |
| Manufacturing: Food/Wood & Paper/Textiles | $1,749,537 | $3,001 | 0.2% |
| Manufacturing: Chemicals/Petroleum/Stone & Glass | $2,611,240 | $4,173 | 0.2% |
| Manufacturing: Computer & Electronic Equipment | $400,783 | $181 | 0.0% |
| Manufacturing: Other | $360,949 | $679 | 0.2% |
| Transportation | $3,204,263 | $4,034 | 0.1% |
| Public Utilities | $826,096 | $5,935 | 0.7% |
| Publishing & Communications | $1,764,467 | $4,932 | 0.3% |
| Trade | $6,729,165 | $27,583 | 0.4% |
| Finance, Insurance, and Real Estate | $2,552,214 | $5,963 | 0.2% |
| Motels & Eating/Drinking & Amusement/Recreation | $2,010,711 | $10,332 | 0.5% |
| Consumer Services | $576,775 | $1,980 | 0.3% |
| Business Services | $4,249,632 | $29,606 | 0.7% |
| Medical/Educational/Social services | $9,315,464 | $22,892 | 0.2% |
| Federal Government | $1,167,112 | $1,419 | 0.1% |
| Provincial Government (less the CCs or TIs) | $1,446,727 | $3,571 | 0.2% |
| 16 Community Colleges and Technical Institutes | $503,715 | $503,715 | 100.0% |
| Total | $48,704,054 | $673,696 | 1.4% |

## Past Student Economic Development Effects: The Direct Effect

Switching now to the past students, the objective is to assign value to the embodied CC and TI CHE's still operative in the local workforce. These skills increase the productivity of the province-wide workforce: existing industry becomes more efficient, competitive, and able to expand product lines. Also, new industry can be attracted to the province. The net effect is an enlargement of the province-wide income, whether existing industry expands or new industry is created.

In **Table 2.13** we derived an estimate of 51.3 million of past CC and TI CHEs embodied in the present-day province-wide workforce. In **Table 3.12**, we detail the steps that take us from CHEs embodied in the workforce to an estimate of the *net* impact of CC and TI instruction on province-wide earnings:

- Step 1: We show the 51.3 million of past CHEs embodied in the current workforce.

- Step 2: As shown earlier in this chapter (**Table 3.3**), the average net value for earnings was reported as $67. The net value was derived as the gross value less



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10%.[27] For the province-wide economic development effect, however, we need to begin with the *gross* value per CHE, or $72.

- Step 3: The product of the total embodied CHEs and the gross value per CHE comprises the initial estimate of the aggregate addition to past student earnings of CC and TI instruction.

- Step 4: In **Chapter 2, Table 2.2** we described the source and meaning of the "alternative education opportunity variable." Absent Alberta's 16 community colleges and technical institutes, 18.3% of the students would still be able to obtain their education elsewhere. This portion of the added earnings is not credited to Alberta's 16 colleges and institutes in the calculation of province-wide growth effects for reasons stated in the previous chapter. The initial estimate of the aggregate addition to past student earnings, therefore, is restated as the net of the alternative education opportunity, indicated in **Table 3.12**.

- Step 5: Finally, the last adjustment reduces the earnings of past students to all but 33% of the previous number. As discussed in detail in **Chapter 2** (see text box on polar cases), the reasons for the significant discounting of past student earnings pertains largely to issues of worker substitution, i.e., the substitution of local skilled for local unskilled workers, and the substitution of out-of-province workers for in-province workers. As for the specific 33% value, this is borrowed from the economics literature on national income growth and education (see: Bils and Klenow, 2000).

Table 3.12. Estimating the Net Provincial Income Effect of Embodied CHEs

| | Variables |
|---|---|
| Total embodied CHEs | 51,335,663 |
| Gross value per CHE | $72 |
| Increased earnings of past students | $3,679,280,041 |
| Alternative education % | 18% |
| Gross earnings attributable to CCs and TIs, net of alternative education variable | $3,005,753,346 |
| Substitution Effects Rate | 33% |
| Net earnings attributable to Alberta CCs and TIs | $991,898,604 |

[27] **Table 3.3** assigns a $67 net per CHE value of instruction at Alberta's 16 community colleges and technical institutes. This is a net value reflecting a 10% reduction from the gross value of $991.90 million to account for a collection of correlation-causation factors as discussed in **Chapter 2** under the section "Annual Private Benefits." Rather than *personal* income effects, however, the present section looks at *regional* income effects. Estimating the latter entails an entirely different set of set of correlation-causation adjustments; hence, we start again with the gross value, $991.90 million.

As shown in the last entry of **Table 3.12**, our analysis concludes that earnings in Alberta are $991.90 million larger than they would be otherwise, because of the skills of past students embodied in the present-day workforce.

The province-wide business community is naturally interested in how the 16 Alberta community colleges and technical institutes affect its operations. This is shown in **Table 3.13**. Beginning with Column 4 in **Table 2.13,** the distribution of historic past student CHEs by industrial sector is translated in **Table 3.13** into the increase in aggregate earnings across these same industrial sectors. The distribution of aggregate earnings is based on the distribution of past student CHEs (**Table 2.13**, Column 4), weighted according to relative industry earnings.

The dollar figures shown in Column 2 of **Table 3.13** indicate how much larger the earnings in these industries are as a direct result of the CC and TI skilled workers they employ. The Finance, Insurance, and Real Estate sector, for example, is estimated to employ CC and TI students with a combined 4,632,044 hours of CHEs (see **Table 2.13**). Because of the skills of these past students, the Finance, Insurance, and Real Estate sector is estimated to generate earnings that are $2.55 million (or 4.0% larger than they would be otherwise). The benefit to the business community is simply this: additional earnings mirror additional business volume, sales revenues, and property incomes. The direct effect of past CC and TI students on other sectors is shown in the table. The province-wide direct effect of past student skills are shown in the bottom row of **Table 3.13**: overall regional earnings are $991.90 million (or 2.0%) higher than they would be absent the 16 Alberta community colleges and technical institutes.

Earnings are larger because outputs are larger, existing industries produce more, and new industries are attracted to the province by the existence of a skilled workforce. The earnings effects shown in **Table 3.13** are called *direct effects*, because they reflect a portion of the increased earnings of past students of Alberta's 16 colleges and institutes.

Table 3.13. Past Student Direct Effects

| | Earnings | | |
|---|---|---|---|
| | Baseline | College Linked | % College Linked |
| | ($1,000) | | |
| Industries | 1 | 2 | 3 |
| Agriculture & Agricultural Services | $854,708 | $1,705 | 0.2% |
| Mining, Sand, and Gravel | $4,873,235 | $9,718 | 0.2% |
| Construction | $3,507,260 | $6,994 | 0.2% |
| Manufacturing: Food/Wood & Paper/Textiles | $1,749,537 | $17,445 | 1.0% |
| Manufacturing: Chemicals/Petroleum/Stone & Glass | $2,611,240 | $52,075 | 2.0% |
| Manufacturing: Computer & Electronic Equipment | $400,783 | $15,985 | 4.0% |
| Manufacturing: Other | $360,949 | $7,198 | 2.0% |
| Transportation | $3,204,263 | $31,951 | 1.0% |
| Public Utilities | $826,096 | $8,237 | 1.0% |
| Publishing & Communications | $1,764,467 | $70,376 | 4.0% |
| Trade | $6,729,165 | $134,196 | 2.0% |
| Finance, Insurance, and Real Estate | $2,552,214 | $101,795 | 4.0% |
| Motels & Eating/Drinking & Amusement/Recreation | $2,010,711 | $20,049 | 1.0% |
| Consumer Services | $576,775 | $5,751 | 1.0% |
| Business Services | $4,249,632 | $84,748 | 2.0% |
| Medical/Educational/Social services | $9,315,464 | $371,548 | 4.0% |
| Federal Government | $1,167,112 | $23,275 | 2.0% |
| Provincial Government | $1,950,442 | $28,851 | 1.5% |
| Total | $48,704,054 | $991,899 | 2.0% |

### Past Student Economic Development Effects: The Indirect Effect

To the direct effects shown in **Table 3.13**, we must now add *indirect effects* stemming from the action of the regional multiplier process. As earnings increase because of higher industry output, the demand for additional industry inputs increases as well. Moreover, with the higher *direct* earnings (shown in **Table 3.13**), workers have more money to spend, which increases sales in consumer-oriented sectors of the economy. On top of these added business inputs and worker expenditures, the action of the provincial multiplier generates still further rounds of industry output and earnings.[28]

Economic development theory describes an *agglomeration effect* whereby regional growth itself stimulates growth (see "The Indirect Economic Development Effects of Students" discussion in **Chapter 2**). In general, agglomeration occurs when additional provincial output attracts new industry, facilitates economies of scale, enhances workforce

[28] The multiplier effects described in this paragraph are traditional "backward" multiplier effects, and are estimated by applying the change in sectoral earnings shown in **Table 3.13** to the Alberta IO model.


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efficiency through information sharing, and otherwise enhances the province-wide business climate.[29]

**Table 3.14** shows the total of the various indirect effects that accompany the direct effects of **Table 3.13**. These effects reflect increased business outputs independent of the actual employment of past CC and TI students in particular sectors: i.e., they reflect the action of the multiplier process.

Table 3.14. Past Student Indirect Effects

| | Earnings | | |
|---|---|---|---|
| Industries | Baseline | College-Linked ($1,000) | % College-Linked |
| Agriculture & Agricultural services | $854,708 | $7,952 | 0.9% |
| Mining, Sand, and Gravel | $4,873,235 | $15,330 | 0.3% |
| Construction | $3,507,260 | $10,790 | 0.3% |
| Manufacturing: Food/Wood & Paper/Textiles | $1,749,537 | $10,487 | 0.6% |
| Manufacturing: Chemicals/Petroleum/Stone & Glass | $2,611,240 | $18,097 | 0.7% |
| Manufacturing: Computer & Electronic Equipment | $400,783 | $1,497 | 0.4% |
| Manufacturing: Other | $360,949 | $3,239 | 0.9% |
| Transportation | $3,204,263 | $21,528 | 0.7% |
| Public Utilities | $826,096 | $6,973 | 0.8% |
| Publishing & Communications | $1,764,467 | $27,578 | 1.6% |
| Trade | $6,729,165 | $71,372 | 1.1% |
| Finance, Insurance, and Real Estate | $2,552,214 | $30,005 | 1.2% |
| Motels & Eating/Drinking & Amusement/Recreation | $2,010,711 | $30,659 | 1.5% |
| Consumer Services | $576,775 | $4,996 | 0.9% |
| Business Services | $4,249,632 | $52,106 | 1.2% |
| Medical/Educational/Social services | $9,315,464 | $92,133 | 1.0% |
| Federal Government | $1,167,112 | $2,996 | 0.3% |
| Provincial Government | $1,950,442 | $35,206 | 1.8% |
| Total | $48,704,054 | $442,943 | 0.9% |

Focusing on particular effects, we can now say that because of the indirect effect of past CC and TI students, earnings in the Provincial Government sector will be $35.21 million (or 1.8%) higher than would otherwise be the case. Other indirect sectoral effects are as shown in the table. The bottom row of **Table 3.14** indicates that region-wide total earnings are $48.70 billion (or 0.9%) larger due to the indirect effect of past CC and TI students.

[29] We estimate agglomeration effects as "forward" multiplier effects. The Alberta IO model is configured to provide a set of so-called supply-driven multipliers (see for example Miller and Blair, 1985). Agglomeration effects are obtained by applying the change in higher stage sectoral earnings from **Table 3.13** to the supply-driven form of the Alberta IO model.



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## Overall Effect of Alberta's 16 CCs and TIs on the Regional Economy

The tables above detail the regional economic effects attributable to Alberta's 16 colleges and institutes in three parts. The effect of day-to-day CC and TI operations and capital spending is shown in **Table 3.11**. The direct effect of past students still active in the workforce is shown in **Table 3.13**. Finally, the indirect effect of past students still active in the workforce is shown in **Table 3.14**. **Table 3.15** combines these separate effects into one summary table.

Table 3.15. Total Effect

| Industries | Baseline | Earnings Linked to CCs and TIs | % Linked to CCs and TIs |
|---|---|---|---|
| | ($1,000) | | |
| Agriculture & Agricultural services | $854,708 | $10,666 | 1.2% |
| Mining, Sand, and Gravel | $4,873,235 | $25,898 | 0.5% |
| Construction | $3,507,260 | $59,624 | 1.7% |
| Manufacturing: Food/Wood & Paper/Textiles | $1,749,537 | $30,933 | 1.8% |
| Manufacturing: Chemicals/Petroleum/Stone & Glass | $2,611,240 | $74,344 | 2.8% |
| Manufacturing: Computer & Electronic Equipment | $400,783 | $17,663 | 4.4% |
| Manufacturing: Other | $360,949 | $11,117 | 3.1% |
| Transportation | $3,204,263 | $57,512 | 1.8% |
| Public Utilities | $826,096 | $21,146 | 2.6% |
| Publishing & Communications | $1,764,467 | $102,885 | 5.8% |
| Trade | $6,729,165 | $233,152 | 3.5% |
| Finance, Insurance, and Real Estate | $2,552,214 | $137,764 | 5.4% |
| Motels & Eating/Drinking & Amusement/Recreation | $2,010,711 | $61,040 | 3.0% |
| Consumer Services | $576,775 | $12,727 | 2.2% |
| Business Services | $4,249,632 | $166,460 | 3.9% |
| Medical/Educational/Social services | $9,315,464 | $486,572 | 5.2% |
| Federal Government | $1,167,112 | $27,691 | 2.4% |
| Provincial Government (less the CCs and TIs) | $1,446,727 | $67,628 | 4.7% |
| Community Colleges and Technical Institutes | $503,715 | $503,715 | 100.0% |
| Total | $48,704,054 | $2,108,538 | 4.3% |

Individual rows in **Table 3.13** show how particular industries benefit from the past and present existence of the 16 Alberta community colleges and technical institutes. For example, our analysis suggests that the Alberta's Publishing & Communications sector owes $1.76 billion (or 5.8%) of its overall earnings to the past and present existence of the 16 Alberta CCs and TIs. The effect of the 16 Alberta colleges and institutes on other industries is shown in the table. The bottom row of **Table 3.15** indicates that region-wide earnings are $48.70 billion (or 4.3%) larger due to the past and present existence of the 16 Alberta community colleges and technical institutes.


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Table 3.16. Summary of Role of CCs and TIs in the Provincial Economy

| | Earnings ($Thousands) | % of Total |
|---|---|---|
| Total Earnings in Province | $48,704,054 | 100% |
| **Earnings Attributable to CC and TI Operations** | | |
| Direct Earnings of Faculty and Staff | $503,715 | 1.0% |
| Indirect Earnings | $169,980 | 0.3% |
| TOTAL | $673,696 | 1.4% |
| **Earnings Attributable to Past Student Econ. Dev. Effects** | | |
| Direct Earnings | $991,899 | 2.0% |
| Indirect Earnings | $442,943 | 0.9% |
| TOTAL | $1,434,842 | 2.9% |
| GRAND TOTAL | $2,108,538 | 4.3% |

**Table 3.16** provides one last view of the regional economic effects of Alberta's 16 community colleges and technical institutes, a fully aggregated view with no industry detail. Consider the items under the heading "Earnings Attributable to CC and TI Operations." The first item is simply the wages and salaries of the faculty and staff of the 16 Alberta colleges and institutes, $503.7 million, or 1.0% of overall province-wide earnings (this item is also shown in college spending **Table 2.11**). The second item shows the indirect effect of CC and TI operations and capital spending: $170.0 million, or 0.3% of all province-wide earnings. All told, the operations and capital spending of the 16 Alberta community colleges and technical institutes can be credited with $673.7 million, or 1.4% of Alberta's $48.7 billion in overall earnings.

The next set of items detail the effect of past CC and TI students still active in the Alberta workforce. Past students directly explain $991.9 million, or 2.0% of all province-wide earnings (shown on the total row of **Table 3.13**). These same students indirectly explain $442.9 million, or 0.9% of all province-wide earnings (shown on the total row of **Table 3.14**). In all, past CC and TI students still active in the workforce can be credited with $1.4 billion, or 2.9% of all earnings in Alberta.

Finally, the bottom row of **Table 3.16** shows the overall role of the community colleges and technical institutes in the Alberta economy: $2.1 billion, or 4.3% of all province-wide earnings.

# Chapter 4
# SENSITIVITY ANALYSIS OF KEY VARIABLES

## INTRODUCTION

We conclude this study with a sensitivity analysis of some key variables on both the investment and regional economic development sides. The purpose of the sensitivity analysis is twofold:

1. *To set our approach apart from "advocacy" education impact analyses.* Many of these may lack uniformity and use assumptions that will not stand up to rigorous peer scrutiny, and they often generate results that grossly overstate benefits. The approach taken here is to account for all relevant variables on both the benefit and cost sides as reflected in the conservatively estimated base case assumptions laid out in **Chapter 2**. The sensitivity tests include: a) the impacts associated with changes in the student employment variables for the investment analysis, and b) the addition of student spending and sales (as opposed to earnings only) to the regional economic development analysis.

2. *To test the sensitivity of the results associated with assumptions for which college researchers have applied judgment and innovative thinking rather than hard data to estimate the numbers.* Some may even refer to these variables as educated guesswork. They include the "Alternative Education" and "Attrition Rate" variables discussed in **Chapter 2**.

## THE STUDENT EMPLOYMENT VARIABLES

Probably the most difficult data to collect are for the two employment variables (because colleges and institutes generally do not collect this kind of information as a matter of formal routine): 1) the percent of the students employed, and 2) of those employed, the earnings received by the students relative to the full earnings they would have received if not attending the 16 Alberta community colleges and technical institutes. Both employment variables relate to the earnings foregone by the students—the opportunity

cost of time—and they affect the investment analysis results (NPV, RR, B/C, and payback period).

### Percent of Students Employed

The students incur substantial expense by attending the community colleges and technical institutes of Alberta because of the time they spend not gainfully employed. Some of that cost is recaptured if the student remains partially (or fully) employed while attending. It is estimated that 79% of the current student body is employed. We test this variable in the sensitivity analysis by changing this assumption to 100%. This change would mean that *all* of the students are employed, reducing the average opportunity cost of time accordingly.

### Percent of Earnings Relative to Full Earnings

The second opportunity cost variable is more difficult to estimate. On average for all 16 colleges and technical institutes, it is estimated that the students working while attending classes earn only 77%, on average, of the earnings they would have statistically received if not attending the CC or TI. This suggests that many of the students hold part-time jobs earning minimum wage (or less than their "statistical" wages). The model captures these differences and counts them as a part of the opportunity cost of time. As above, we test this variable in the sensitivity analysis by changing the assumption to 100%. This would mean that the students are fully employed, and the average opportunity cost of time would be reduced accordingly.

### Results

The changed assumptions (both of which would be consistent with advocacy analysis) generate the results summarized in **Table 4.1**. Here, the base case assumptions taken from **Table 2.2** are reflected in the two shaded rows for the variables tested—79% for the portion of students employed, and 77% for their earnings relative to the statistical averages. These (base case) assumptions are held constant in the shaded rows for the student perspective. The sensitivity analysis results are shown in the non-shaded rows—the extent to which the investment analysis results would change if the two base case variables were increased to 100%, first separately, and second, together. Changing both

assumptions to 100% (all students fully employed) would automatically increase the benefits because the opportunity cost of time would reduce to zero.

1. Increasing the students employed assumption from 79% to 100% first (holding all of the other assumptions constant), the RR, B/C, and payback period results would improve to 19.2%, 5.7, and 7.6 years, respectively, relative to the base case results. The improved results are attributable to a lower opportunity cost of time—all students would be employed in this case.

2. Increasing the earnings relative to the statistical averages from 77% to 100% second (holding the second employment assumption constant at the base case level), the RR, B/C, and payback period results would improve to 20.2%, 6.1, and 7.2 years, respectively, relative to the base case results—a strong improvement over the base case results, again attributable to a lower opportunity cost of time.

3. Finally, increasing both of the above assumptions to 100% simultaneously, the RR, B/C, and payback period results would improve yet further to 67.2%, 21.7, and 2.7 years, respectively, relative to the base case results. This scenario assumes that all students are fully employed and earning full salaries (equal to the statistical averages) while attending classes. These results are unrealistic, albeit not uncommon for advocacy analyses.

Table 4.1 Sensitivity Analysis of Student Perspective

| Variables | Assumptions | RR | B/C | Payback |
|---|---|---|---|---|
| 1. Percent | 79% | 14.0% | 3.8 | 10.1 |
| Employed | 100% | 19.2% | 5.7 | 7.6 |
| 2. Percent of | 77% | 14.0% | 3.8 | 10.1 |
| Earnings | 100% | 20.2% | 6.1 | 7.2 |
| 1 = 100%, 2 = 100% | | 67.2% | 21.7 | 2.7 |

**A final note to this section—we strongly emphasize that the base case results are very attractive—the results are all well above their threshold levels, and the payback periods are short.** As clearly demonstrated here, advocacy results *appear* much more attractive, although they would overstate the benefits. The results presented in **Chapter 3** are *realistic*, indicating that investments in Alberta's 16 community colleges and technical institutes will generate excellent returns, well above the long-term average percent rates of return of roughly 7% in the stock and bond markets.



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## PROVINCE-WIDE ECONOMIC DEVELOPMENT

The economic impacts of higher education can be calculated in different ways. Our approach was to estimate the economic impacts of the 16 community colleges and technical institutes in the province in based on CC and TI operations and capital spending (**Table 3.16**), and the increased productivity effects of past students in the regional workforce. The impacts were expressed in terms of regional *earnings*, i.e., area wages, salaries and proprietors' income, published by Statistics Canada. Others often add student spending to the impacts and express the results in terms of sales instead of earnings—both will substantially inflate the numerical measures of the impacts so that they appear larger than they really are. In the present section we address these two issues: 1) the addition of student spending effects to impact estimates, and 2) the expression of economic impacts in terms of regional gross sales rather than earnings.

### The Economic Impact of Student Spending

Students spend money while attending college: they buy books and supplies, rent rooms, purchase food, pay for transportation, attend sports events, go to movies, and so on. These expenditures create jobs and incomes for local businesses, which, as argued by some, should be counted among the regional economic impacts attributable to the college or institute.

In our analysis, however, we exclude student spending because most of the students already reside in the province. Student expenditures, therefore, do not represent new monies in the region, but rather a redirection of monies that would have been spent anyway. The other side of the argument is that, even though the college-related spending of a resident student does not constitute new money, some students would leave the province to obtain an education elsewhere if the college or institute were not present. Thus, the province loses the spending and related jobs and incomes. Both cases have merit, although we believe the former is more reasonable than the latter. This is because only a few students will actually be able to avail themselves of an education elsewhere (see **Table 2.9**). Our approach, therefore, is to exclude student spending, recognizing at the same time, that the regional impact estimates may err on the conservative side.

In **Table 4.2** we show the potential magnitude of student spending effects in the provincial economy. The table parallels **Table 3.16** in the previous chapter, but adds the section "Earnings Attributable to Student Spending,"[30] creating some $217.6 million in additional earnings for the local businesses patronized by students (the direct effects), plus another $109.6 million in earnings stemming from related multiplier effects (indirect effects). Adding the student spending to the mix increases the CC and TI total "explanatory power" of the regional earnings from 4.3% in **Table 3.16** to 5.0% in **Table 4.2.**

Table 4.2. Summary of Role of CCs and TIs in the Province Economy

| | Earnings ($ Thousands) | % of Total |
|---|---|---|
| Total Earnings in Province | $48,704,054 | 100% |
| **Earnings Attributable to Student Spending** | | |
| Direct Earnings | $217,626 | 0.4% |
| Indirect Earnings | $109,632 | 0.2% |
| TOTAL | $327,258 | 0.7% |
| **Earnings Attributable to CC and TI Operations** | | |
| Direct Earnings of Faculty and Staff | $503,715 | 1.0% |
| Indirect Earnings | $169,980 | 0.3% |
| TOTAL | $673,696 | 1.4% |
| **Earnings Attributable to Past Student Econ. Dev. Effects** | | |
| Direct Earnings | $991,899 | 2.0% |
| Indirect Earnings | $442,943 | 0.9% |
| TOTAL | $1,434,842 | 2.9% |
| GRAND TOTAL | $2,435,795 | 5.0% |

## Economic Impacts Reported as Gross Sales

Advocates sometimes favor gross sales over earnings as an impact measure, because sales are always larger than the earnings. Using this as an impact measure has notable drawbacks, however. An immediate drawback is that, unlike earnings, there is generally no published total against which a sales impact can be measured. More importantly though, the most troublesome aspect of gross sales impact measures is captured in the following example:

[30] We estimated student-spending effects by borrowing average college student information from a study conducted for higher education economic impacts in Illinois (University of Illinois, 2000). Student spending by broad expenditure category was bridged to the sectors of the province-wide economy input-output model. Adjustments were made consistent with the model's regional accounts to allow for spending leakages.

Two visitors spend $50,000 each in the economic region. One visits a local auto dealer and purchases a new luxury automobile. The other undergoes a medical procedure at the local hospital. In terms of direct economic impact, both have spent $50,000. However, the expenditures will likely have very different meanings to the provincial economy. Of the $50,000 spent for the luxury automobile, perhaps $10,000 remains in-province as salesperson commissions and auto dealer income (part of the economic region's overall earnings), while the other $40,000 leaves the province for Ontario or somewhere else as wholesale payment for the new automobile. Contrast this to the hospital expenditure. Here perhaps $40,000 appears as physician, nurse, and assorted hospital employee wages (part of the economic region's overall earnings), while only $10,000 leaves the province, to pay for hospital supplies, or to help amortize building and equipment loans. In terms of sales, both have the same impact, while in terms of earnings, the former has one-fourth the impact of the latter.

**Table 4.3** expresses the impacts of Alberta's 16 colleges and institutes in terms of gross sales rather than earnings. Note that gross sales measures are everywhere larger than earnings. The economy-wide measure of total gross sales estimated by the economic model is $159.3 billion.[31] Direct local spending by students reflects their total spending, reduced by the estimated portion that leaks out-of-province to purchase goods produced elsewhere.[32] In the usual fashion, indirect effects reflect the action of local economic multiplier effects, also estimated by the economic model.

Direct local expenditures include all spending by the college or institute for consumer items and for faculty and staff salaries. Both items are reduced to reflect purchases from outside the province. All told, the operation of the 16 colleges and technical institutes is estimated to explain some $5,921.9 million in regional gross sales, a number substantially larger than the $2,435.8 million explained by the colleges and institutes in regional gross earnings shown in **Table 4.2**.

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[31] Simply stated, economy-wide gross sales are obtained by multiplying sector-specific regional earnings by a national estimate of sales-to-earnings.

[32] Students purchase gasoline for their cars, for example, and while the trade margin stays in-province, in most cases the producer price of gasoline itself will leak out to the oil-producing region.

Table 4.3. Summary of College Role in the Regional Economy

| | Gross Sales (1,000) | % of Total |
|---|---|---|
| Total Gross Sales in College-Hosting Region | $159,296,579 | 100% |
| **Gross Sales Attributable to Student Spending** | | |
| Direct Local Spending by Students | $644,892 | 0.4% |
| Indirect Spending Effect | $340,069 | 0.2% |
| TOTAL | $984,962 | 0.6% |
| **Gross Sales Attributable to College Operations** | | |
| Direct Local Expenditures of CC | $304,775 | 0.2% |
| Indirect Spending Effect | $204,997 | 0.1% |
| TOTAL | $509,772 | 0.3% |
| **Gross Sales Attributable to Past Student Econ. Dev. Effects** | | |
| Direct Gross Sales | $3,046,189 | 1.9% |
| Indirect Gross Sales | $1,380,936 | 0.9% |
| TOTAL | $4,427,125 | 2.8% |
| GRAND TOTAL | $5,921,859 | 3.7% |

While the gross sales impacts shown in **Table 4.3** are not incorrect, we prefer to report CC and TI impacts in terms of earnings (**Table 3.16**) rather than gross sales, because they reflect the economic realities in the province much more accurately. Advocacy studies, on the other hand, will often opt to express the results in terms of sales because the numbers are much more impressive. Such results, however, will likely not stand up to rigorous peer scrutiny in the economics profession.

## VARIABLES REQUIRING "JUDGMENT"

The sensitivity analysis used here is a simple tool often used to determine "switching" values, which occur when the investment results turn from positive to negative, or from attractive to non-attractive as the assumptions are varied up and down. If the results change dramatically with only a small variation in the assumption, then that assumption is sensitive. If the results do not change much, the assumption is not sensitive, and minute accuracy in its specification is less important. The sensitivity analysis is also used to demonstrate how some results become unrealistic when advocacy assumptions are invoked.

Two variables have consistently raised concerns among institutional researchers—the "Alternative Education Opportunity" and "Attrition Rate" variables discussed in detail in **Tables 2.9** and **2.2**, respectively. Neither can be specified on the basis of hard data collected on a regular basis by the college or institute; rather, they are based on well-informed judgments made by faculty and staff intimately familiar with the student

body. Recall from **Chapter 2** that the alternative education opportunity variable (18.3% in **Table 2.9**) is characterized as a "negative benefit"—the taxpayer benefits are reduced by the percent indicated to account for the portion of the current student body who could obtain a similar education elsewhere, absent the college or institute. The attrition rate (33% in **Table 2.2**) characterizes the mobility of the exiting students out of the region over the next 30 years or so through retirement, out-migration and/or death.

Given the nature of these variables and the difficulty in accurately specifying them, the obvious question is: how great a role do they play in the magnitudes of the results? The results are presented in the sensitivity analysis **Table 4.4**.

Table 4.4 Sensitivity Analysis of Alternative Education and Attrition Rate Variables

| | | -75% | -50% | -25% | Base Case | 25% | 50% | 75% |
|---|---|---|---|---|---|---|---|---|
| **Alternative Education Variable** | | 4.6% | 9.2% | 13.73% | 18% | 22.88% | 27.5% | 32.0% |
| *Narrow Taxpayer Perspective* | | | | | | | | |
| *Investment results* | NPV | $718,132 | $674,242 | $630,351 | $586,460 | $542,569 | $498,679 | $454,788 |
| | RR | 18.8% | 18.0% | 17.2% | 16.4% | 15.6% | 14.8% | 14.0% |
| | B/C ratio | 2.7 | 2.6 | 2.5 | 2.4 | 2.3 | 2.2 | 2.1 |
| | Pay Back | 7.2 | 7.4 | 7.7 | 8.1 | 8.4 | 8.8 | 9.3 |
| | | -75% | -50% | -25% | Base Case | 25% | 50% | 75% |
| **Attrition Rate Variable** | | 8.3% | 16.7% | 25.00% | 33% | 41.66% | 50.0% | 58.3% |
| *Regional Economic Development* | | | | | | | | |
| Earnings Attributable to College | | $2,315,724 | $2,249,617 | $2,180,721 | $2,108,538 | $2,032,399 | $1,951,377 | $1,864,117 |
| % of Total Earnings in Province | | 4.8% | 4.6% | 4.5% | 4.3% | 4.2% | 4.0% | 3.8% |
| Credits Embodied in the Workforce | | 58,748,338 | 56,383,185 | 53,918,244 | 51,335,663 | 48,611,561 | 45,712,760 | 42,590,809 |

## Alternative Education Opportunity

Variations in the Alternative Education assumption are calculated around the base case assumptions listed in the middle column of **Table 4.4** for the taxpayer perspective results (the variable does not affect the student investment analysis results). The NPV, RR, B/C and payback results listed in the base case column were all presented and discussed in **Chapter 3**. Next, we bracket the base case assumption on either side with plus or minus 25%, 50% and 75% variation in the assumptions. The analyses are then redone introducing one change at a time, holding all the other variables constant. For example, an increase of 25% in the Alternative Education assumption (from 18% to 22.88%) will reduce the narrow taxpayer perspective RR from 16.4% to 15.6%. Likewise, a decrease of 25% (from 18% to 14%) in the assumption will generate an increase in the RR from 16.4% to 17.2%.



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Based on this sensitivity analysis, the conclusion can be drawn that the Alberta CC and TI investment analysis results from the narrow taxpayer perspective are not very sensitive to relatively large variations in the Alternative Education variable. As indicated, the results are still well above their threshold levels (NPV greater than 0, B/C ratio greater than 1, and RR greater than the discount rate of 4%) even when the Alternative Education assumption is increased by as much as 75% (from 18% to 32%). The conclusion is simply that, although the assumption is difficult to specify and will require judgment on the part of the institutional researcher, its impact on the overall investment analysis results for the narrow taxpayer perspective is not very sensitive.

### Attrition Variable

The attrition rate variable only affects the regional economic development results (**Table 3.16**). As above, we increase and decrease the assumption relative to the base case assumption of 33% (from **Table 2.2**) by the increments indicated in the table. The impacts on the results are more pronounced, as indicated in **Table 4.4**. Earnings attributable to the community college or institute, for example, range from a high of $2,315,724 at -75% to a low of $1,864,117 at a 75% variation from the base case assumption for this variable. This means that, if the attrition of the ex-students over time increases, the number of CHEs embodied in the current local workforce decreases; hence, the earnings attributable to the college or institute decrease accordingly.

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# Appendix 1: Explaining the Results—a Primer

The purpose of this appendix is to provide some context and meaning to investment analysis results in general, using the simple hypothetical example summarized in **Table 1** below. The table shows the projected (assumed) benefits and costs over time for one student and the associated investment analysis results.[33]

Table 1. Costs and Benefits

| | Tuition | Opportunity Cost | Total cost | Higher Earnings | NCF |
|---|---|---|---|---|---|
| 1 | $1,500 | $20,000 | $21,500 | $0 | ($21,500) |
| 2 | $0 | $0 | $0 | $5,000 | $5,000 |
| 3 | $0 | $0 | $0 | $5,000 | $5,000 |
| 4 | $0 | $0 | $0 | $5,000 | $5,000 |
| 5 | $0 | $0 | $0 | $5,000 | $5,000 |
| 6 | $0 | $0 | $0 | $5,000 | $5,000 |
| 7 | $0 | $0 | $0 | $5,000 | $5,000 |
| 8 | $0 | $0 | $0 | $5,000 | $5,000 |
| 9 | $0 | $0 | $0 | $5,000 | $5,000 |
| 10 | $0 | $0 | $0 | $5,000 | $5,000 |
| NPV | | | $20,673 | $35,747 | $15,074 |
| IRR | | | | | 18% |
| B/C ratio | | | | | 1.7 |
| Payback period | | | | | 4.2 years |

The assumptions are as follows:

1) The time horizon is 10 years—i.e., we project the benefits and costs out 10 years into the future (Column 1). Once the higher education has been earned, the benefits of higher earnings remain with the student into the future. Our objective is to measure these future benefits and compare them to the costs of the education.

2) The student attends the CC or TI for one year for which he or she pays a tuition of $1,500 (Column 2).

[33] Note that this is a hypothetical example. The numbers used are not based on data collected from any of the community colleges.



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3) The opportunity cost of time (the earnings foregone while attending the CC or TI for one year) for this student is estimated at $20,000 (Column 3).

4) Together, these two cost elements ($21,500 total) represent the out-of-pocket investment made by the student (Column 4).

5) In return, we assume that the student, having completed the one year of study, will earn $5,000 more per year than he would have without the education (Column 5).

6) Finally, the net cash flow column (NCF) in Column 6 shows higher earnings (Column 5) less the total cost (Column 4).

7) We assume a "going rate" of interest of 4%, the rate of return from alternative investment schemes, for the use of the $21,500.

Now the "mechanics"—we express the results in standard investment analysis terms: the net present value (NPV), the internal rate of return (IRR—or, as referred to in the main report, simply the rate of return—RR), the benefit/cost ratio (B/C), and the payback period. Each of these is briefly explained below in the context of the cash flow numbers in **Table 1**.

## THE NET PRESENT VALUE (NPV)

"A bird in hand is worth two in the bush." This simple folk wisdom lies at the heart of any economic analysis of investments lasting more than one year. The student we are tracking in **Table 1** has choices: a) to attend the CC or TI, or b) forget about higher education and hold on to the present employment. If he or she decides to enroll, certain economic implications unfold: the tuition must be paid and earnings will cease for one year. In exchange, the student calculates that, with the higher education, his or her income will increase by at least the $5,000 per year as indicated in the table.

The question is simple: will the prospective student be economically better off by choosing to enroll? If we add up the higher earnings of $5,000 per year for the remaining nine years in **Table 1**, the total will be $45,000. Compared to a total investment of $21,500, this appears to be a very solid investment. The reality, however, is different—the benefits are far lower than $45,000 because future money is worth less than present

money. The costs (tuition plus foregone earnings) are felt immediately because they are incurred today—in the present. The benefits (higher earnings), on the other hand, occur in the future. They are not yet available. We must discount all future benefits by the going rate of interest (referred to as the discount rate) to be able to express them in present value terms.[34] A brief example: at 4%, the present value of $5,000 to be received one year from today is $4,807. If the $5,000 were to be received in year 10, the present value would reduce to $3,377. Or put another way, $4,807 deposited in the bank today earning 4% interest will grow to $5,000 in one year; and $3,377 deposited today would grow to $5,000 in 10 years. An "economically rational" person would, therefore, be equally satisfied receiving $3,377 today or $5,000 10 years from today given the going rate of interest of 4%. The process of discounting—finding the present value of future higher earnings—allows us to express values on an equal basis in future or present value terms.

Our goal is to express all future higher earnings in present value terms so that we can compare them to the investments incurred today—the tuition and foregone earnings. As indicated in **Table 1**, the cumulative present value of the flow of $5,000 worth of higher earnings between years 2 and 10 is $35,747 given the 4% interest rate, far lower than the undiscounted $45,000 discussed above.

The measure we are looking for is the NPV result of $15,074. It is simply the present value of the benefits less the present value of the costs, or $35,747 - $20,673 = $15,074. In other words, the present value of benefits exceeds the present value of costs by as much as $15,074. The criterion for an economically worthwhile investment is that the NPV is equal to or greater than zero. Given this result, it can be concluded that, *in this case*, and given these assumptions, this particular investment in CC or TI education is very strong.

## The Internal Rate of Return (IRR)

The IRR is another way of measuring the worth of the investment in education using the same cash flows shown in **Table 1**. In technical terms—the IRR is a measure of the average earning power of the money used over the life of the investment. It is simply the interest rate that makes the NPV equal to zero. In the NPV example above we applied

[34] Technically, the **interest rate** is applied to compounding—the process of looking at deposits today and determining how much they will be worth in the future. The same interest rate is called a **discount rate** when we reverse the process—determining the present value of future earnings.

the "going rate" of interest of 4% and computed a positive NPV of $15,074. The question now is: what would the interest rate have to be in order to reduce the NPV to zero? Obviously it would have to be higher—18% in fact, as indicated in **Table 1**. Or, if we applied 18% to the NPV calculations instead of the 4%, then the NPV would reduce to zero.

What does this mean? The IRR of 18% defines a breakeven solution—the point where the present value of benefits just equals the present value of costs, or where the NPV equals zero. Or, at 18%, the higher incomes of $5,000 per year for the next 9 years will earn back all the investments of $21,500 made plus pay 18% for the use of that money (the $21,500) in the meantime. Is this a good return? Indeed it is—first, if we compare it to the 4% "going rate" of interest we applied to the NPV calculations, 18% is far higher than 4%. We can conclude, therefore, that the investment in this case is solid. Alternatively, we can compare the rate to the long-term 7% rate or so obtained from investments in stocks and bonds. Again, the 18% is far higher, indicating that the investment in CC or TI education is strong relative to the stock market returns (on average).

A word of caution—the IRR approach can sometimes generate "wild" or "unbelievable" results—percentages that defy the imagination. Technically, the approach requires at least one negative cash flow (tuition plus opportunity cost of time) to offset all subsequent positive flows. For example, if the student works full time while attending college, the opportunity cost of time would be much lower—the only out-of-pocket cost would be the $1,500 paid for tuition. In this case, it is still possible to compute the IRR, but it would be a staggering 333% because only a negative $1,500 cash flow will be offsetting 9 subsequent years of $5,000 worth of higher earnings. The 333% return is technically correct, but not consistent with conventional understanding of returns expressed as percentages. For purposes of this report, therefore, we express all results in the main report exceeding 100% simply as: "> than 100%."

## The Benefit/Cost Ratio (B/C)

The B/C ratio is simply the present value of benefits divided by present value of costs, or $35,747 / $21,500 = 1.7 (based on the 4% discount rate). Of course, any change in the discount rate will also change the B/C ratio. If we applied the 18% IRR discussed above, the B/C ratio would reduce to 1.0—or the breakeven solution where benefits just equal

the costs. Applying a discount rate higher than the 18 percent would reduce the ratio to less than one and the investment would not be feasible. The 1.7 ratio means that a dollar invested today will return a **cumulative** $1.70 over the 10-year time period.

## THE PAYBACK PERIOD

This is the length of time from the beginning of the investment (consisting of the tuition plus the earnings foregone) until the higher future earnings return the investments made. In **Table 1**, it will take roughly 4.2 years of $5,000 worth of higher earnings to recapture the student's investment of $1,500 in tuition and the $20,000 earnings he or she foregoes while attending the CC or TI. The higher earnings occurring *beyond* the 4.2 years are the returns (the "gravy") that make the investment in education *in this example*, economically worthwhile. The payback period is a fairly rough, albeit common, means of choosing between investments. The shorter the payback period is, the stronger the investment will be.

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